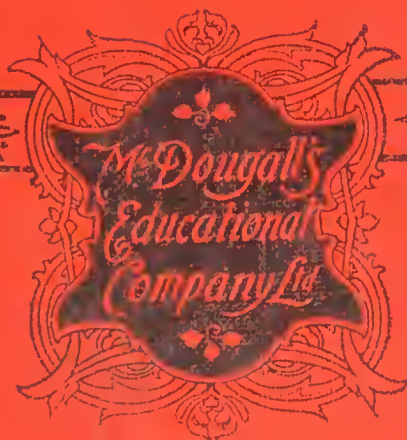




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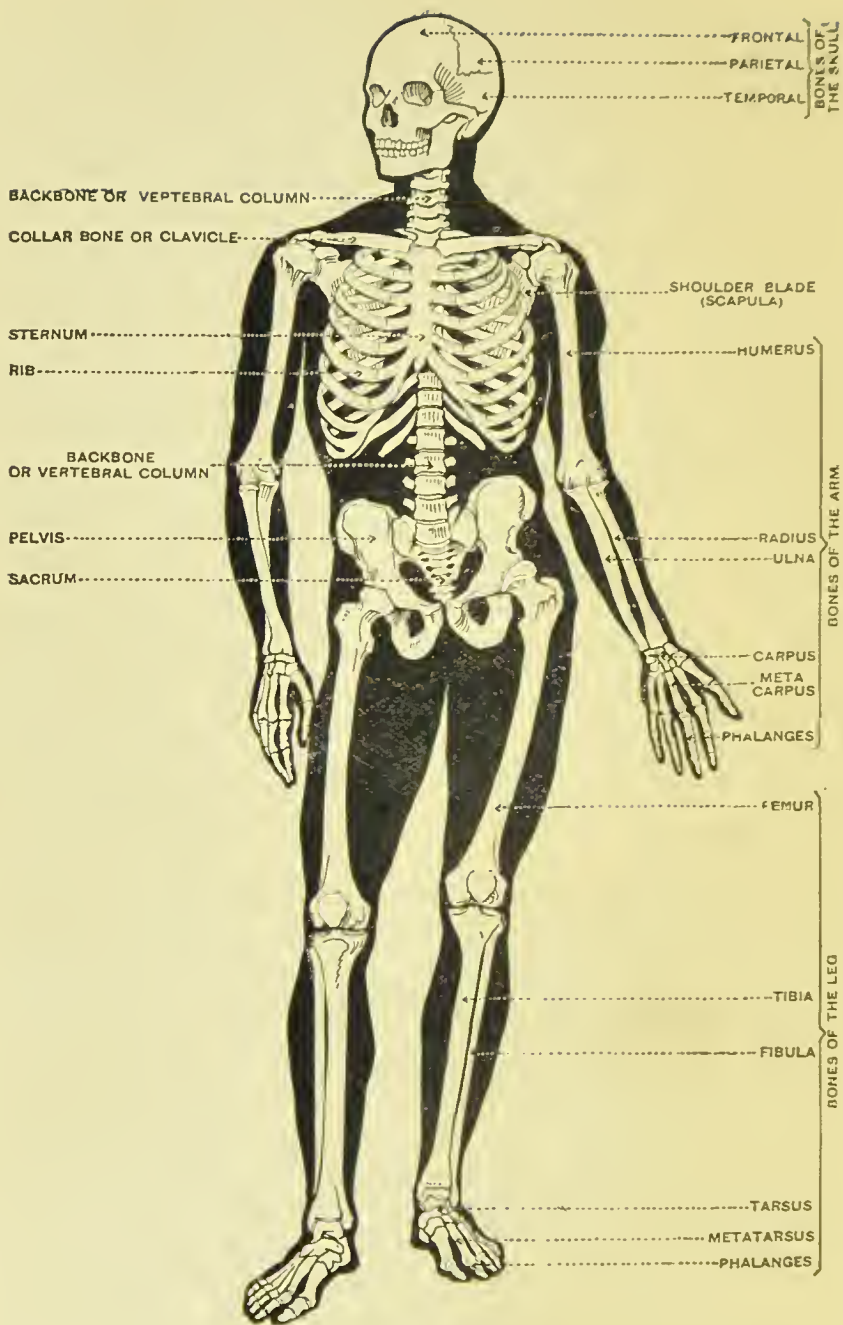
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THE SKELETON.



LAWS OF HEALTH.

CHAPTER I.

THE CHIEF ORGANS OF THE BODY AND THEIR FUNCTIONS.

I. THE SKELETON.

The **skeleton** is the solid framework of the body. It is mainly formed of **bones** with the addition in some parts of **cartilages** or gristle.

Cartilage (gristle) is a dense, firm, elastic, and semi-transparent substance, of a whitish colour and closely resembling gelatine in composition. **Bone** is usually formed first as a mass of cartilage. As age increases it becomes hardened by the addition throughout its substance of various salts of lime, chiefly the phosphate and the carbonate.

Bone may then be said to consist of two distinct but closely united portions:—

- (1) **Animal matter**—cartilage ;
- (2) **Earthy matter**—chiefly salts of lime.

If a bone be steeped in hydrochloric acid the earthy part will be dissolved and the animal part will remain, and will show not only the general outline of the bone but also its structure. It is tough and elastic, and if boiled will be resolved almost entirely into gelatine.

On the other hand, the earthy matter may be obtained separately by burning the bone carefully in an open fire. The animal portion will be consumed and the exact form of the bone will remain as a soft gray brittle mass of the various salts of lime and other earthy matters contained in the bone.

If these experiments are carefully carried out and the animal and earthy parts of a bone weighed separately, it will be found that their proportions by weight are roughly—

Animal part—one third ;

Earthy part—two thirds.

The exact proportions, however, vary with the period of life. In early life there is a larger proportion of animal matter—the bones are more like cartilage. In later life the bones are composed more largely of the earthy matters. It follows that in infants and children the bones are more liable to bend and hence to cause deformity ; while in old age the bones are more brittle and when broken are more difficult to unite.

The skeleton

- (1) supports the other parts of the body ;
- (2) gives attachment to the various muscles of the body, by which movements are made ;
- and (3) protects the more delicate organs from injury.

Bones are :—

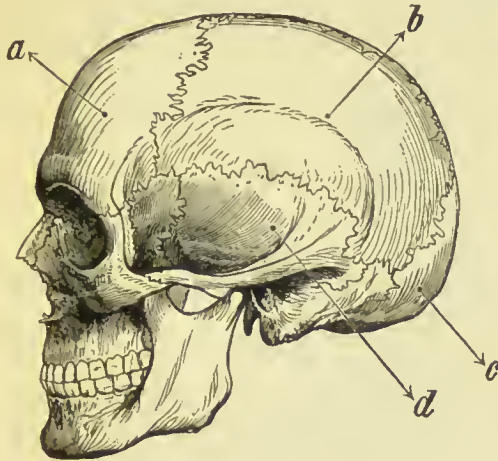
- (1) **long** or **cylindrical**, as the bones of the arm or leg ;
- (2) **flat**, as the shoulder-blade and the larger bones of the skull ;
- (3) **short** and more or less rounded, as the bones of the ankle and wrist ;
- or (4) **irregular**, as the bones of the spinal column.

Long bones are smooth and round and have their ends thicker and covered with a smooth cartilage. Some are hollow and filled with marrow, and thus size and strength are obtained without undue weight.

Bones are surrounded, except at joints, with a tough covering to which the muscles and tendons are attached, and in which the blood-vessels which go to nourish the bones are distributed. Tiny blood-vessels also pass throughout every part of the bones, which are also supplied with nerves to a limited extent.

The number of bones in the body varies at different periods of life, some which are separate in youth becoming united in mature life.

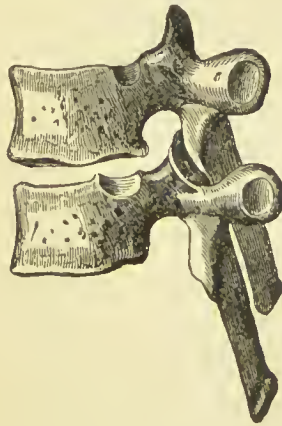
In middle life there are about two hundred bones in the body.



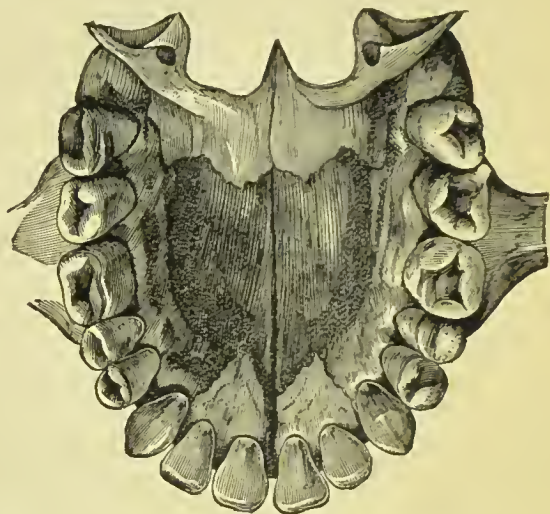
PRINCIPAL BONES OF THE SKULL—

a. Frontal bone. *b.* Parietal. *c.* Occipital. *d.* Temporal.

- (1) The bones of the skull and face (22) united by firm and immovable joints with the exception of the lower jaw which is hinge-jointed. They protect the brain and the organs of sight, hearing, smell, and taste.
- (2) The bones of the spinal column or backbone (24). Between these are elastic pads of cartilage which give a certain freedom of movement and break the force of jolts or jars as in jumping.
- (3) The breastbone and the ribs (25—12 ribs on each side). They protect the heart, the lungs, and the great blood-vessels.
- (4) The bones of the pelvis (3),—the rump and the two haunch bones.



- (5) The bones of the upper limbs (64),—shoulder-blade, collar-bone, arm-bone, fore-arm bones, bones of wrist, palm, and fingers.
- (6) The bones of the lower limbs (60),—thigh bone, leg bones, kneecap, bones of the ankle, instep, and toes.



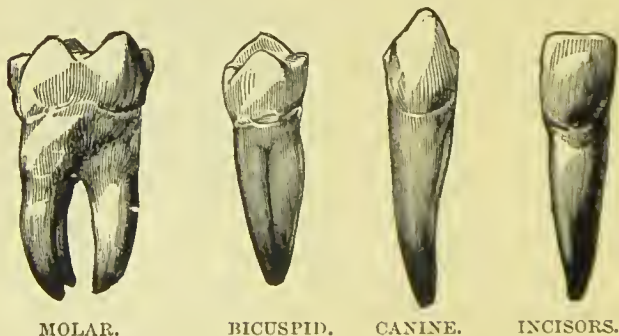
The Teeth.—In the adult these are thirty-two in number, consisting of the following in each jaw :—

Four incisors—the front teeth—for cutting.

Two canine teeth—for tearing.

Four bicuspid teeth } —for crushing.

Six molars



MOLAR.

BICUSPID.

CANINE.

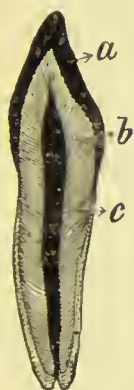
INCISORS.

The first or temporary set of teeth are twenty in number, consisting of four incisors, two canine teeth and four molars in each jaw. These are gradually replaced by the adult teeth

from about the seventh year of age, the last molars popularly known as the "wisdom teeth," appearing from the 17th to the 25th year of age.

Each tooth consists of a **crown** and a **fang** or root, the latter in the case of the molars being forked, that is, divided into two, three, or even four parts.

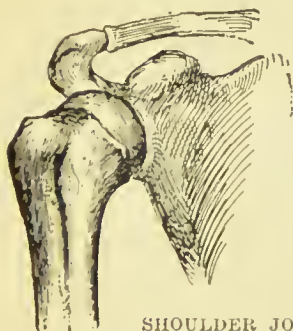
If a tooth be divided lengthwise it will be seen to be composed of **several parts**.



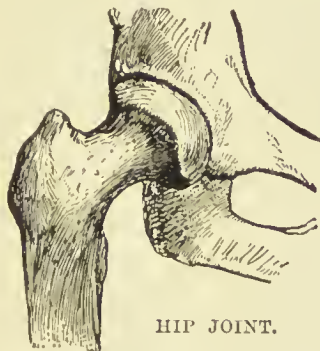
a Enamel
b Cementum
c Pulp Cavity

The crown is coated with a dense white substance known as **enamel** (*a*). Beneath this and forming the outer part of the fang is another less dense substance known as **cementum** (*b*). At the end of the fang is a perforation through which blood-vessels and nerves pass to the **pulp** (*c*).

Decay of the Teeth.—This is caused by the formation of what is known as "tartar" upon the teeth. This is a kind of encrustation formed of the animal matter and earthy salts of the food together with the saliva. It should be regularly removed by brushing, otherwise the enamel decays and breaks off, leaving the softer cementum exposed. This in turn is destroyed and the pulp with its nerves is then exposed.



SHOULDER JOINT.



HIP JOINT.

II. THE JOINTS.

A **Joint** is where two or more bones meet. Usually some softer substance (as **cartilage**) lies between the bones, uniting or covering the surfaces which come together, and where one bone moves against the other there is also a **sac** supplying

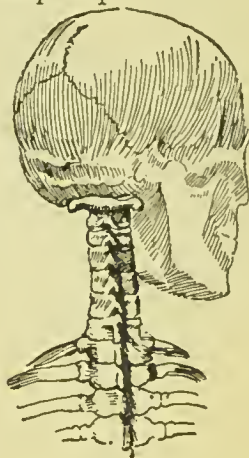
an oily fluid to lubricate the joint. In such cases, too, there are strong **ligaments** binding the bones together.

The principal varieties of joints are given in the following list.

- (1) **Ball and socket joints**, where the rounded end of one bone moves in the cup-shaped end of another, as the shoulder joint and the hip joint. The amount of movement in such a joint depends on the shallowness of the cup. The shoulder joint is a shallow cup, the hip joint is a deep cup.



KNEE.



NECK.

HINGE AND PIVOT JOINTS.



ELBOW.

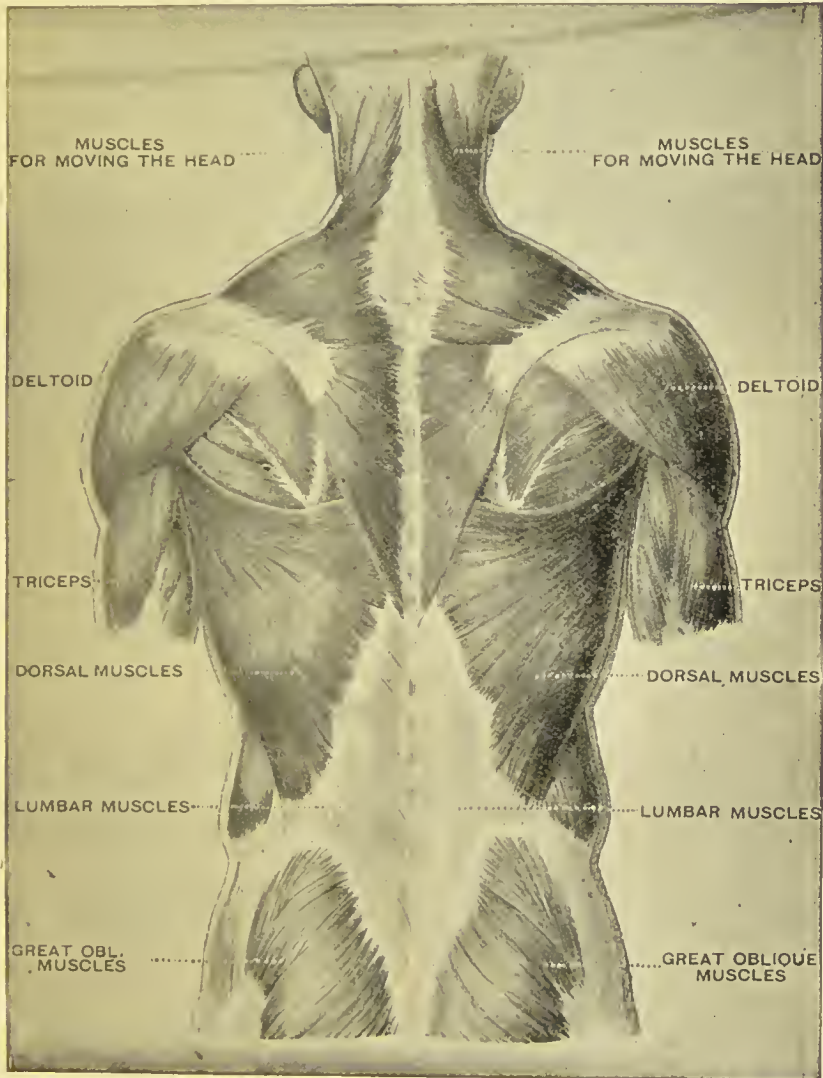
- (2) **Hinge-joints**, which may be single or double. Single hinge-joints are found in the elbow, the knee, and the ankle. The joint of the thumb bone with the wrist bone is a double hinge-joint, for it allows movement in several directions and not merely in one as in the above cases.
- (3) **Pivot-joints**, where one bone turns around another as an axis. Examples are found in the neck and the forearm.

III. THE MUSCLES.

The **muscles** are the **fleshy portions** of the body, and it is by them, through the influence of the nerves, that the **various movements** are effected.

The muscles are composed of **fibres**, which are bound

up with connective tissue and blood-vessels, etc. into small bundles. By means of **tendons** the muscles are attached to bones, etc. for the purposes of movement. They are largely supplied with **nerves** as well as with **blood-vessels**.



THE MUSCLES OF THE BACK.

Each fibre of a muscle has the power of **contracting**. This term is applied to the shortening in the length of a fibre or muscle while it increases correspondingly in girth.

It is not to be supposed that in *contracting* the total bulk of the muscle is decreased.

When, thus, a muscle contracts, it brings its two ends nearer together, and as these are fixed to bones one or other or both of these are moved. In order to cause the muscle to contract, a **message** (or a nerve-current) must first pass from the **brain** along the **nerve** which traverses the muscle. The movement of the muscle is thus under the control of the will. These muscles are known as **Voluntary Muscles**. There are, however, many muscles which are not in any sense under the control of the will. Such are the muscles of the heart, the walls of the stomach, etc. These are known as **Involuntary Muscles**, and are controlled by messages from nerve centres, chiefly in the spinal cord.

The muscles are placed, arranged, and shaped in strict accordance with the work they are expected to do. The thicker a muscle is, the heavier work it can perform. Thus in the arm and the thigh the muscles form thick masses, whereas in the cheeks they are thin and flat.

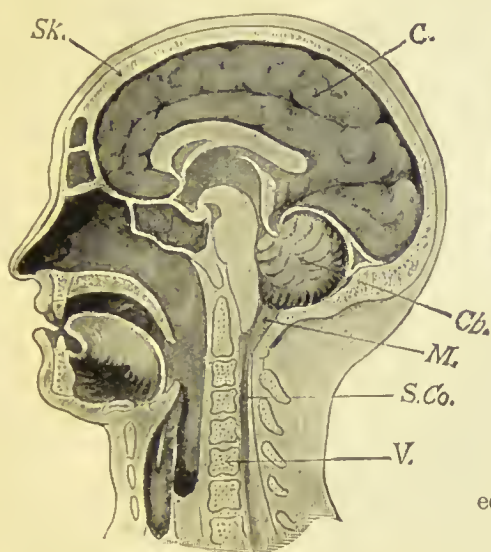
IV. THE NERVOUS SYSTEM.

The nervous system consists of four parts.

1. The **Brain** is a mass of white and gray matter occupying the hollow of the skull, the strong bones of which protect it from injury. The chief parts of the brain are three in number.

- a. The **Cerebrum** or brain proper forms the larger mass of the brain. The surface is of a gray colour, and it is disposed in many folds known as **convolutions**. This part is the organ of thought, of feeling, and of will.
- b. The **Cerebellum** or little brain lies at the back of the head, and has much to do with regulating the movements of the body.
- c. The **Medulla Oblongata** is the part which gradually narrows and passes into the spinal cord. At this part many nerves cross from one side of the brain to the opposite side of the spinal cord. Hence it is that an injury to one side of the brain injures (causes paralysis to) the *opposite* side of the body. This part has also to do with regulating breathing, swallowing, etc.

2. The **Spinal Cord** is a continuation of the medulla oblongata through the hollow of the Spinal Column. Nerves are given off in pairs from the spinal cord to the various parts of the body.



CEREBRUM
looked at from above.
To show division into
equal parts or Hemispheres.

Sk. Bone of the Skull.	C. Cerebrum.	Cb. Cerebellum.
M. Medulla Oblongata.	S.Co. Spinal Cord.	V. Vertebra.

3. The **nerves** themselves are white threads consisting of fibres in sheaths. They carry messages to and from the brain, and are accordingly distinguished as *sensory* nerves (conveying messages of sensation, etc. to the brain), and *motor* nerves (conveying messages from the brain which result in motion).

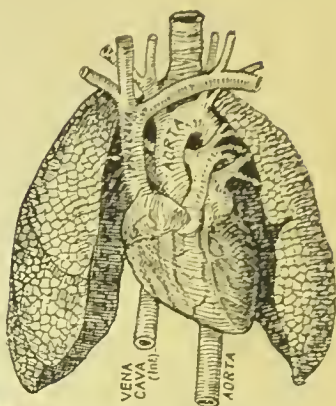
4. The **Sympathetic System** is situated chiefly on each side of the spinal column and consists of distinct separate *ganglia* or knots of nerves. These are connected with the main nervous system, and control the organs of digestion, etc.

V. BLOOD AND THE CIRCULATION.

The **Blood** is the great feeder of every part of the body. None of the organs can grow properly or perform their functions aright unless they are supplied with a constant stream of rich and pure blood.



H. THE HEART.
THE WHITE
LINES ARE
ARTERIES,
THE CROSSED
LINES ARE
VEINS.



LUNGS, HEART, AND
PRINCIPAL VESSELS

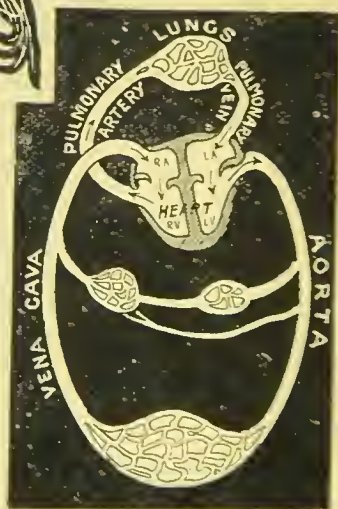


DIAGRAM TO EXPLAIN
CIRCULATION

THE CIRCULATION OF THE BLOOD

Blood consists of:—

- (1) A **clear yellowish liquid**—the plasma ;
- (2) many **small bodies**, the **corpuscles**, mostly **red** and thus giving the characteristic colour to the blood, while a few are **white**.



BLOOD CORPUSCLES.

A, B, C. Red corpuscles seen from different points.
D, D. Colourless corpuscles.

Coagulation. Blood when freshly drawn is a fluid rather thicker than water. It soon becomes thicker and then sets into a jelly. This is known as a **clot**, and has the effect in the case of a wound, of helping to stop the bleeding. By and by drops of a clear liquid ooze from the clot, which shrinks as the quantity of liquid increases.

Functions of the blood.

- (1) To **oxidise** and to **carry away waste matters** from the body.

Waste matters (chiefly in the form of carbonic acid gas, etc.) are constantly being formed as a result of exercise. The blood brings with it (in the red corpuscles) a supply of oxygen. Some of the waste matters are oxidised (burnt up) by this oxygen. The others are carried away in the liquid part of the blood and got rid of by the lungs, the skin, or the kidneys.

- (2) To bring fresh materials to take the place of waste matters.

Digested food is brought (from the stomach, etc.) by the liquid parts of the blood, and oxygen (from the lungs) by the red corpuscles.

The white corpuscles are mainly engaged in repairing the tissues and in repelling disease, and perhaps they produce the red corpuscles.

The Circulation. The blood in the body is in constant motion. It leaves the left side of the heart in a great artery, the aorta, which gives off branches to supply the various parts of the body. They divide into smaller



SECTION OF THE HEART AND LUNGS.

The blood leaves the heart by the Aorta, flowing into the arteries, returning to it by the Venæ Cavæ; it is now pumped by the lower part of the heart into the pulmonary arteries at A that lead into the lungs, where it is purified by contact with the air we breathe. It is now returned to the left side of the heart by the pulmonary veins B, and passes to the lower part, from which it is pumped into the Aorta.

and smaller branches, the smallest of which are finer than the finest hair. These are the *capillaries*, which are in every part of the body in such numbers and so close together that a prick with a needle-point ruptures the walls of several of them.

Still moving onwards the blood begins to pass from the capillaries into larger vessels known as **veins**, in which it is carried back to the heart, entering by the **right** side by two large veins, the **Superior** and **Inferior Venæ Cavæ**.

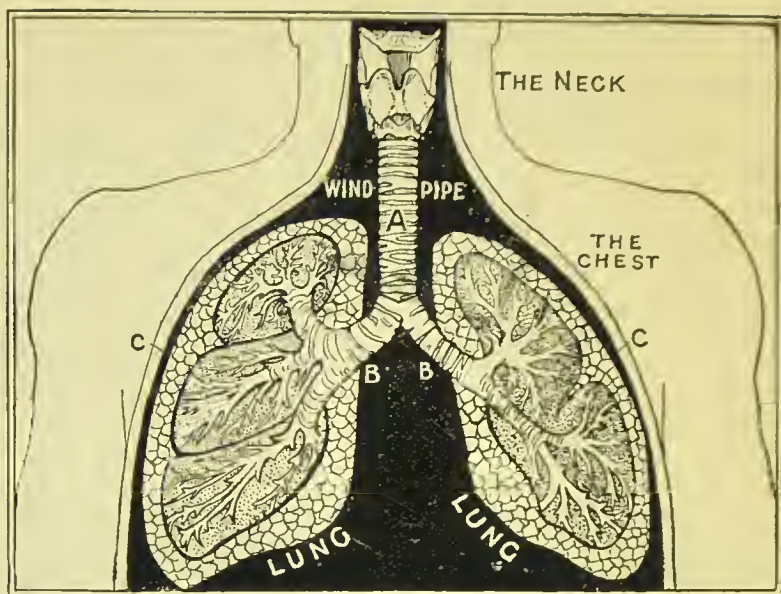
This is the **first half** of the circulation. While in the capillaries the blood gives up part of its supply of food and of oxygen, receiving in exchange the waste matters. This has the effect of changing the colour of the blood somewhat. It is **bright red** in the arteries, but in the veins becomes of a duller, more **purple** hue as it returns to the heart without its full supply of oxygen and charged with carbonic acid gas.

These waste matters have now to be removed in the **second part** of the circulation. There is a strong partition between the right and left sides of the heart, and the **venous** (impure) blood which has been brought back to the right side is sent out again from the same side to pass through the lungs. It is carried thither by the **Pulmonary Artery**, which divides into branches and capillaries in the lungs. Here it meets with the air we breathe, and gives off the carbonic acid gas it has brought from the tissues, receiving in exchange the life-giving oxygen. Passing onward it is again gathered up by the **Pulmonary Vein** and carried back to the left side of the heart, where it is ready once more to commence its double circulation. As it is carried past the stomach and intestines it gathers a **fresh store of nourishing food** to be distributed to all parts of the body. The digested food or **chyle** which is not directly absorbed into the blood is carried by the **lacteals** into the thoracic duct, which finally pours it into one of the great veins before it enters the heart.

It will be readily understood from the above that a **good supply of rich and pure blood** is of the greatest importance.

This cannot be ensured without

- (1) **Proper nourishment**—good and nourishing food taken in proper quantity and at suitable times ;
- (2) **Fresh air**—to ensure a sufficient supply of oxygen to meet the blood in the lungs ;
- (3) **Sufficient exercise**—that the blood may be kept in active circulation.



A. Trachea or Windpipe. B, B. Right Bronchus and left Bronchus.
C, C. Right and left Lungs.

VI. THE LUNGS AND RESPIRATION.

The **Lungs** are two large spongy bags lying in the chest, one on each side of the heart. Each lung is divided into a very large number of pockets containing air.

Inspiration. When the chest is expanded the air rushes in by the mouth or nostrils and fills these pockets. In the walls of these little pockets is a net-work of capillaries. Thus the fresh air and the venous blood are brought very closely into contact and through the very thin walls of the capillaries the exchange takes place. Carbonic acid and water vapour are given off and oxygen enters the blood to take their place.

Expiration. When the expansion of the chest is completed it returns to its former size, and the air containing the above impurities is driven out.

The chief differences between the **air breathed in** and the **air breathed out** are noted below.

- (1) The air breathed in may be **cold**, or **cool**, or **warm**, but the air breathed out is **hot**.

Test this by breathing on the bulb of a thermometer.

- (2) There is a much larger quantity of **carbonic acid gas** in the **air breathed out** than in that breathed in.

This can be shown by breathing out through a tube passing into lime water. The carbonic acid gas joins with the dissolved lime and forms chalk, which falls to the bottom as a white powder. Atmospheric air contains very little carbonic acid gas, and accordingly has no appreciable effect on lime water.

- (3) Expired air contains more **water** than that inspired. Show this by breathing on a cool mirror, when the water vapour contained in the expired air will be condensed by the cold surface of the mirror.
- (4) Expired air contains much more **organic matter**, which may be of a poisonous nature.

VII. THE SKIN AND THE KIDNEYS.

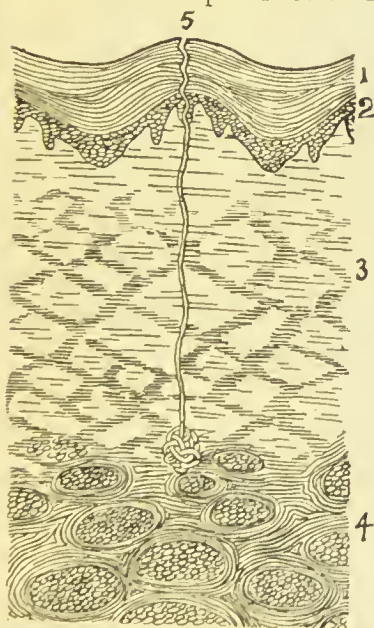
The skin and the kidneys are also agents in the removal of **waste matters** from the blood.

The **kidneys** lie in the small of the back, one on each side of the spinal column. They get rid of much water, together with other waste material dissolved in it.

The **skin** also, by means of perspiration (or sweat), much of which is invisible, gives off water and waste material. If these waste materials are allowed to accumulate and not removed they act as poisons in the blood.

The **skin** consists of two distinct layers:—

- (1) The **True Skin** or **Derma**, which contains blood-vessels and nerves, and through which the sweat glands pass;
- (2) The **Upper Skin** or **Epidermis**, consisting of more or less flattened scales, which are being constantly shed off and replaced from below, but containing no nerves or blood-vessels.



A SECTION OF SKIN greatly magnified.

1. Epidermis.
2. Colouring matter.
3. Derma.
4. Fat layer.
5. A pore at the mouth of a sweat duct leading from a sweat gland.

Functions of the Skin.

- (1) It **removes waste material** from the blood.
- (2) It **covers and protects** the body.
- (3) It is an **organ of touch**. The nerves in the skin end in minute rounded bodies which are most numerous on the tips of the fingers, the tongue, etc. From these messages are conveyed to the brain and interpreted by it as hardness or softness, sharpness, heat or cold, etc.
- (4) The skin **regulates the heat** of the body. In cold weather the blood-vessels in the true skin contract so that little blood passes through them, and consequently little heat is lost into the atmosphere. In warmer weather they expand and are filled with the hot blood. Much heat is then given off and the body is cooled.

VIII. DIGESTION.

We cannot move a muscle or speak a word, we cannot even think, without some part of our body (muscle or brain) being worn out and becoming not only useless but positively harmful if allowed to remain. We have seen that these waste matters are constantly being removed from the body by the agency of the lungs, the skin, and the kidneys.

It has already been indicated that to replace such worn-out parts we require to supply fresh materials regularly.

The **new material** we take in in the form of

- (1) **Fresh air,**
 - (2) **Water,**
- and (3) **Food.**

Each of these is necessary, and without them a man will die. Without a regular and sufficient supply of each a man will not be healthy.

The **fresh air**, as has already been shown, is taken in by the lungs.

The **water and food** are taken into the system by means of the **mouth, the stomach, and the intestines.**

[For details of the different classes of foods see Chapter III.]

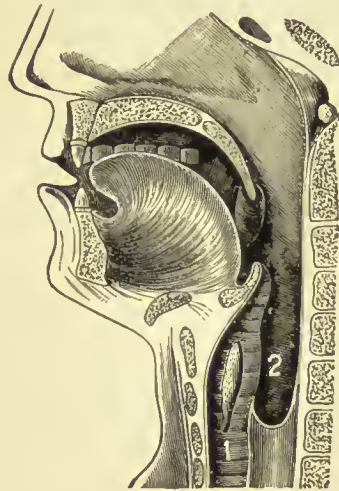
Food to be of the utmost service in repairing the worn-out tissues must be

- (1) **carefully selected** so that each part of the body may receive a suitable supply of nourishment;
- (2) **correctly cooked** so that digestion may be carried on most easily;
- (3) **properly eaten** so that digestion may be begun in the mouth and carried forward in the stomach and bowels without undue hindrance.

Digestion is carried forward in **three distinct stages**.

1. **In the mouth.**

- (1) The food is **masticated** (chewed) by the teeth and thus is broken into small pieces. It is moistened by a juice (**saliva**) which flows from glands under the tongue and in the sides of the mouth.



THE MOUTH.

1. WINDPIPE.

2. GULLET.

- (2) The saliva has the effect of converting **starchy foods** into sugar, which is then easily absorbed.
- (3) Certain **salts** are dissolved by the saliva.

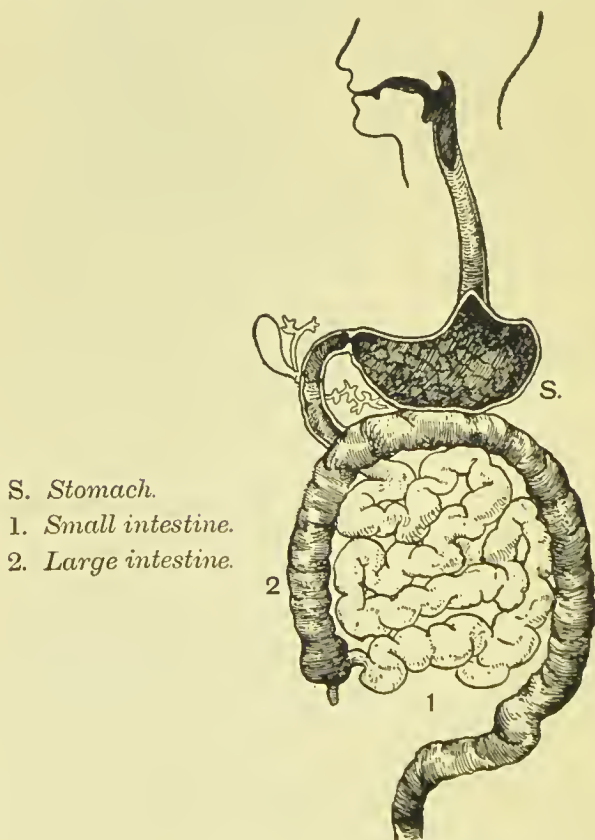
2. **In the Stomach.**—The food after being properly masticated passes down the **gullet** (a tube that lies behind the windpipe) and enters the stomach.

Gastric juice flows from small pits in the walls of the stomach, and the walls themselves begin to contract and relax. This has the effect of thoroughly mixing the gastric juice with the food. Here

- (1) the **albumin** contained in the food is dissolved;
- (2) the cells containing **fatty matter** are dissolved and their contents set free as oils.

3. **In the Intestines.**—The food now passes into the intestines or bowels. It is at once mixed with (1) bile from the liver, and (2) pancreatic juice from the pancreas. The former emulsifies the fatty matters (reduces them to a milky condition): the latter digests the fat and has also some effect in the further digestion of starch and albumin. The intestines constantly add a juice of their own (*intestinal juice*) which has a digestive effect on cane sugar, but whose chief purpose is to keep the food liquid.

Absorption: The walls of the stomach and intestines contain many very fine capillaries. From the blood in these the various juices are taken; and to it is added the liquid digested food, which is then, partly by direct absorption, partly through the lacteals and the thoracic duct, carried into the general circulation and replaces the worn-out material.



S. *Stomach.*

1. *Small intestine.*

2. *Large intestine.*

CHAPTER II.

AIR AND WATER; THEIR COMPOSITION AND CHIEF IMPURITIES.

I. AIR.

1. If we set a glass of cold water in a warm room drops of moisture collect upon the outside of it. Where has this **moisture** come from? A person who uses spectacles, on going from a cold room to a warm one, finds his spectacles grow dim. The glass is covered with a film of moisture. The moisture in both cases is deposited on the cold surface from the air.

This shows that water (**watery vapour**, we should say, as it is invisible) forms one constituent of the atmosphere. Rain, clouds, and fog all prove the same.

The amount of watery vapour in the air varies greatly. Warm air will hold more than cold. Hence it is that the cold glass cooling the air in its immediate neighbourhood, the cooled air is unable to hold all its watery vapour, and part of it is deposited upon the cold glass.

2. The air near the surface of the earth contains many particles of **dust**. A beam of light admitted into a darkened room will show myriads of them. If a red hot poker be brought suddenly into the beam the dust particles in its immediate neighbourhood are consumed and the beam becomes invisible. Besides dust the air is impregnated with living and dead particles of **organic matter**, **germs** of disease, etc. The amount of dust and germs in the air varies greatly, being greatest in large cities and smallest in the open country.

3. Float a small piece of phosphorus* the size of a pea upon a slice of cork in a basin of water. Set it alight and immediately cover with a bell-jar. The phosphorus will burn brightly, sending off dense white fumes. When it goes out the fumes will gradually settle and dissolve in the water. Note that the water has risen by about one-fifth in the jar. A part of the air has been used up by the phosphorus; this

* Phosphorus is highly inflammable and must be kept and cut under water. It should be lifted on the point of a knife and not handled,

part is the gas **oxygen** which alone supports burning and animal life.

Hence we conclude that **oxygen** forms about one-fifth of the atmosphere.

4. The gas left in the bell-jar may be tested and it will be found that nothing will burn and nothing will live in it. This remaining gas is a mixture consisting mainly of **nitrogen**. Nitrogen is an inert gas, whose chief use in the atmosphere is to dilute the oxygen which alone is too powerful.

5. If an open cup of lime water be allowed to sit in a room for a few days it will become milky in colour. This shows the presence of **carbonic acid gas** in the atmosphere. Carbonic acid gas supports neither combustion nor life and indeed is a distinct poison. It does not make up more than three or four parts in ten thousand in the open air, and in these proportions is not harmful; but if allowed to accumulate in rooms (where it is given off from persons, animals, fires and lamps) it is very harmful.

6. Chemists find traces of other gases in the air; as **Argon**, which like nitrogen is an inert gas, merely serving to dilute the oxygen; **Ammonia**, which usually is present in very minute quantities, and **Ozone**, an intense form of oxygen, the quantities of which are small and variable, it being found mostly in air near or over the ocean.

THE ATMOSPHERE CONTAINS

OXYGEN . . .	which supports combustion and life	almost $\frac{1}{5}$ of the bulk
NITROGEN . .	inert	about $\frac{4}{5}$ of the bulk
CARBONIC ACID GAS	poisonous	about $\frac{1}{25000}$ of the bulk
ARGON, &c. . .	inert	nearly $\frac{1}{100}$ of the bulk
AMMONIA . . .	poisonous	minute quantities
OZONE	stimulating	
WATERY VAPOUR .	source of rain, etc. . .	varying greatly
DUST, GERMS, ETC. .	hurtful .	varying greatly

II. WATER.

Water is one of the necessities of life, and a generous supply of pure drinking water is one of its greatest blessings and one of the best safeguards of health.

Composition of Water.—Water is not a **simple or elementary** substance—that is, it does not consist of only one kind of matter. Neither is it a **mixture** of several kinds of matter like air. It is a **chemical compound** of oxygen and hydrogen. These are two colourless gases, and when united they form an altogether new substance quite different from either. This compound is the liquid we know as water.

The composition can be **demonstrated** in two ways.

- (1) Water may be decomposed by passing an electric current through it, when oxygen is collected at the one pole and hydrogen at the other. It will be found further that the hydrogen is given off in about double the volume of the oxygen.
- (2) If hydrogen and oxygen in the proportion of two parts of the former to one part of the latter be exploded in a very strong bottle, drops of water will be formed.

Hence we conclude that the chemical composition of pure water is

2 parts of Hydrogen

1 part of Oxygen.

Properties of Water.—Water forms a large part (more than half) of the weight of all animals and plants. It covers three-fourths of the entire surface of the earth. As we have already seen it is always present in the form of vapour, clouds, etc. in the atmosphere.

When perfectly pure, water has **neither taste, smell nor colour**. It is the **best solvent known**. Some substances are very easily dissolved in water; others are dissolved with difficulty, but it is believed that all substances are more or less soluble in water. On this account, it will be readily understood that in Nature it is **impossible** to find water **absolutely pure**.

The **Ocean** is the great storehouse of the world's water. From it and from seas, lakes, rivers, and even from the soil, water is being constantly taken into the atmosphere as vapour (mainly invisible). It falls as rain, snow, etc.

sinks into the ground, reappears as springs, or flows on the surface in rivers back to the oceans and seas.

Sea Water naturally contains many substances in solution, the chief of which is **common salt** (sodium chloride). **Salts of magnesium** (the sulphate and the chloride of magnesium) are also present in less quantities, and it is from them that sea water obtains its bitter taste. **Salts of lime** are carried in large quantity by rivers into the ocean, but are **extracted** by shell-fish, etc., for the formation of their shells, and hence salts of lime are not found to any great degree in sea-water. Sea water is, of course, quite **unsuitable for domestic purposes**.

River water holds fewer salts in solution than does sea water; and both their nature and quantity depend upon the rocks over which the river flows. Lime salts form a large proportion of the solids dissolved in most rivers. There is usually, however, in river water much **organic matter**, living, decaying, and dead, and this is very harmful if the water is used for drinking. Where, however, the river is shallow with a pebbly bottom the water is found to be fairly free from organic matter, the stones serving as a **natural filter**. Many rivers also carry a considerable quantity of **suspended matter**, chiefly in the form of sand, and this they deposit at their mouths.

To render river water suitable for drinking it should be **filtered**, that is, passed through some porous substance, whose pores keep back the solid matters without preventing the passage of the liquid.

For domestic use, **unglazed porcelain** filters are the best. On a large scale for town supplies, water is filtered through **successive beds** of fine sand, coarse sand, broken shells, fine gravel, and coarse gravel. The finer layers of this filter require to be renewed frequently.

River water which is contaminated by **sewage** and the **refuse** from towns and factories is unsuitable for drinking.

Lake Water resembles river water in most respects, lakes being usually expansions of rivers, although some lakes are fed by springs. The water of remote mountain lakes, provided they are not stagnant, is usually wholesome. Many such lakes supply large cities with water.

Spring Water.—When the rain sinks into the ground it may come to clay or other substance through which it cannot pass. It then accumulates and will probably run along the surface of the clay and find its way out by an opening on



A RESERVOIR.

the surface of the hillside. The **dissolved matter** in spring water depends upon the nature of the rocks over which it has gathered and through which it has passed. **Carbonate of lime** is perhaps the commonest of such salts. As a rule, unless the dissolved salts are in excess (as in medicinal springs) the water of springs is **suitable for drinking**. It is not, however, so suitable for the purpose of **washing**. When carbonate of lime is dissolved in water containing carbonic acid gas the water is known as **hard water**. The lime acts upon the soap used in washing and they form an insoluble curd of "lime soap." Hard water will not dissolve soap and form a lather until all the dissolved lime has thus been converted into lime soap.

The "hardness" of such water may be destroyed by **boiling**. This expels the carbonic acid gas, and the carbonate of lime is deposited as a white crust or fur on the kettle or boiler.

Some spring waters contain sulphate of lime or magnesium, and these cannot be softened by boiling. **Washing soda**, however, added to the water destroys these sulphates.

Rain Water naturally contains none of the above salts and is known as **soft water**. Any impurities it contains are washed out of the air. Accordingly, if collected in the open country and after rain has fallen for some time it is fairly pure. It is, however, unpalatable on account of its lack of salts and is not pleasant for drinking. For washing it is an ideal water. The rain water collected in towns contains many dangerous impurities obtained from the soot and smoke.

Well Water.—**Surface wells**, not extending to any great depth—twenty to thirty feet at most—are common in country places. They collect the water which has passed through the surface soil and consequently are not always safe, unless care is taken that **sewage** cannot possibly find its way into them.

Artesian wells are deep borings from which the water rushes up with more or less force. The water of artesian wells usually contains much **carbonic acid gas** in solution, and so is sparkling and pleasant to the taste. The **salts** the water contains, like those of springs, depend on the rocks from which the water is gathered.

Storage and Delivery of Water.—In the case of large cities and towns the water is stored in specially constructed reservoirs and delivered through iron and lead pipes. Ordinary water has a solvent effect on lead, and solutions of lead are all poisonous. Hence if water has been standing in lead pipes or cisterns for any length of time (for example during the night) it is wise to run the tap for a little before taking water for drinking. In places where drinking water has to be stored in tanks or cisterns attention should be paid to the **material** of which the cistern is constructed, and to its **position**.

- (1) **Stone or slate** if well put together forms a good cistern. **Galvanised iron** is also very suitable; but **lead** for the reason before stated is objectionable. In all cases the cistern should be **regularly cleaned out** unless in the case of a lead cistern, where the water forms a coating on the surface, which if undisturbed, will prevent to some extent any further solution.
- (2) The cistern should have a closely-fitting lid; it should be ventilated and it should be placed away from any closets, etc. from which gases might arise and contaminate the water.

CHAPTER III.

FOOD.

Food ; its necessity.—The human body has been very aptly compared to a steam engine. Each consists of many different parts skilfully fitted together, and every part is admirably adapted to perform its own work. Each must be supplied with force or energy to give it the power of doing work, and each, too, wears away as it works.

To the engine the energy is supplied by steam which is obtained from boiling water. As the different parts of the engine become worn or damaged they can be repaired by the skilful mechanic, or worn parts may be entirely removed and new parts supplied.

In a somewhat similar way we may look at the body. Heat and energy must be supplied to it before any work can be performed. These are both obtained in large measure from the food that we eat. Like the engine, too, our bodies or the substances of which they are composed are being constantly worn out. It has already been mentioned, in Chapter I., that we cannot do any work at all, we cannot move an eyelid, we cannot even think without thereby wearing out some portion of our body and rendering it of no further use. This constant waste must be made good if our bodies are to continue fit to live and to work, and this, too, is accomplished by the food that we eat.

In childhood and youth, when the body is growing in size and when the waste is smaller than in later life, more food is eaten than is required merely to supply heat and energy and to repair waste. A portion is utilised in increasing the size of the bones, muscles, and other parts of the body.

Food is therefore necessary

- (1) to supply heat and force or energy,
- (2) to provide material to take the place of worn-out matter,
- (3) to provide material for the growing body.

Classification of Foods.—The different articles of food are arranged in classes according to the chief element present in them. They are mostly the production of life—animal or vegetable—that is, they are **organic**, but some, as common salt, are **inorganic**.

1. **Nitrogenous foods.**—These are composed of **Nitrogen** together with oxygen, hydrogen, carbon, sulphur, and in some cases phosphorus. They are also known variously as **Proteids** **Albuminoids** or **Flesh formers**. Examples of these foods are to be found in eggs, butcher meat, fish, fowls, peas, beans, milk, cheese, oatmeal, wheat, flour, etc. A very large amount of nitrogen daily passes from the body in the form of waste matter, and consequently a daily supply of nitrogen is necessary to repair this waste. Nitrogen food can be supplied to the body in no other form than as proteids or albuminoids.

There are four chief forms of nitrogenous foods.

- (1) **Albumin.**—The white of egg is almost wholly composed of albumin, and it forms at least a third part of the yolk. A substance very similar to egg-albumin is found in blood and another in muscle.
- (2) **Glutin.**—This is obtained from the seeds of the cereals as oats and wheat. If flour be put into a muslin bag and thoroughly washed in running water, the starch which it contains will be carried away and the sticky substance remaining is almost pure glutin.
- (3) **Casein.**—This is contained in milk, cheese, etc. If an acid be added to fresh milk, a curd is formed which is mainly composed of the casein.
- (4) **Legumin.**—This is a nitrogenous food found in such seeds as peas, beans, lentils, etc. It is very similar to casein.

2 **Non-nitrogenous Foods.**—There are several classes of these differing widely among themselves, but having this in common that they do not contain nitrogen and consequently can take no part in the renewal of the nitrogenous waste of the body.

- (1) **Starches and Sugars.**—These are generally of vegetable origin, although a natural sugar is found in milk also. They are of great value as foods in helping to maintain animal heat, in imparting force or energy, and in the formation of fatty tissue in the body.

Starch is very widely diffused and is found in the form of small grains. It forms the greater part of potatoes and of the seeds of cereals. Among the common foods consisting largely of starch are arrowroot, rice, sago, potatoes, oat and wheaten bread.

Sugar is of several kinds, as **Cane sugar**, taken from the juice of the sugar cane. Exactly the same in composition is the sugar obtained from beet-root, sugar-maple, etc.

Grape sugar (glucose) is found in grapes and other fruits, and **Milk sugar** is obtained from milk.

- (2) **Fats**.—These are either of animal or of vegetable origin. As foods they perform important functions in repairing and renewing fatty tissues and in helping in the digestion of other foods. In addition, like the starches and sugars, they serve to maintain the heat of the body and to produce force and energy. On this account they are in greater demand as food during cold weather and in cold countries. Examples of fatty foods are butter, margarine, etc., the fat of butcher meat; oils contained in vegetables as onions, leeks, etc., and in various seeds, nuts, etc.
- (3) **Mineral Salts**.—These are quite a necessary form of food. They aid in the repair and renewal of various parts of the body, help to form some of the digestive juices, contribute to the formation of bone, especially in the young, and assist in enriching the blood. Examples are common salt, compounds of lime, potash, soda, magnesium and iron, which are found in milk, meat, spring-water, fruits, vegetables, seeds, etc.
- (4) **Vegetable Acids**.—These can scarcely be regarded strictly as foods, and yet they exercise so important an influence that their entire absence for any length of time from the food consumed leads to illness and even death. Among them are citric acid found in oranges, lemons, gooseberries, currants, strawberries, raspberries, etc., tartaric acid in grapes, raisins, etc., malic acid in apples, pears, etc., and oxalic acid in rhubarb and in certain plants not eaten as food, as wood-sorrel and the common dock.

A Mixed Diet.—In order to provide for the maintenance of heat and the production of energy as well as for the due repair and renewal of the various tissues, a mixed diet is essential. No single purely nitrogenous food and no single purely non-nitrogenous food can support life unless for a very short time. It is necessary that the diet contain at least one nitrogenous and one non-nitrogenous food; and if it is to be continued for any length of time, mineral salts and vegetable acids must be added. The best form of diet, however, is that

which gives proteids, starches, sugars, fats, acids, and salts, and if possible, a variety of each class. Some articles of food, as milk, actually contain all these elements in themselves and are thus capable of sustaining life. Other articles of food require to be supplemented or added to by those which contain the elements wanting.

The exact proportions of the various elements of food which should form part of the dietary vary according to the circumstances of the case, but the following may be taken as a rough average :

Starches and Sugars,	20	parts
Nitrogenous foods,	10	„
Fats, ...	5	„
Salts, Acids etc. .	2	„

Digestibility of Food.—Perhaps the most easily digested of the starchy foods are white bread and rice. Nitrogenous and fatty foods obtained from the vegetable world cost less than those obtained from the animal world, but as a rule they are not so easily digested. Their cooking and mastication (chewing) require more care. They are said also to have less of a stimulating effect upon the system.

Times of Eating.—An average meal is believed to take about four hours to digest. Allowing time for the stomach to rest, food should probably be taken during the day at intervals not exceeding five or six hours. If the interval is too long it is harmful, and not less so is the habit of eating too frequently. The first meal should be taken soon after rising. Those who have to begin their day's work very early and return for breakfast should endeavour to have a cup of hot tea or coffee and a biscuit or a little bread before going out. The last meal of the day should be taken a full hour before bed-time. It should not be a heavy meal, as the stomach will continue working and prevent sound sleep; or if sound sleep is obtained the work of digestion is impaired or interrupted and the person rises in the morning with the undigested food in his stomach.

Preparation of Food.—Food having been selected in proper variety so that it may contain the most suitable kinds of nourishment, has still to be cooked. This renders it softer, more agreeable to the palate and more easily digestible. Some foods, for example milk, apples, etc., may be taken uncooked,

but for most articles of diet cooking is a necessity. Thus the fibrous sheath which encloses the albumin in meat is transformed into a soft gelatine by cooking. Uncooked, the sheath would offer great resistance to the digestive juices. The starchy particles in vegetables and grains are enclosed in indigestible cellulose walls, which, however, are burst by the process of cooking. Again both meat and vegetables may contain parasites or germs of disease. These might do great harm if they were allowed to enter the human body. Thorough cooking, however, destroys them and renders them perfectly harmless.

How to eat. All food, whether solid or liquid, should be taken **slowly**. If solid it should be thoroughly chewed by the teeth and mixed with the saliva of the mouth. This juice has much to do with the thorough digestion of starches; by its action starch is converted into a variety of sugar. Food eaten quickly is not properly broken up and consequently the digestive juices of the mouth and stomach cannot penetrate it. The result is that it lies too long in the stomach and is likely to cause indigestion. Besides, if the food is not properly mixed with saliva, the first step in the digestion of the starch is not taken. Much or all of it passes through the stomach undigested.

During meals, one should not read or study, as any mental work interferes with digestion. Cheerful talk helps to make a meal enjoyable and prevents it from being taken too hurriedly.

Only a little water should be taken during a meal, as water tends to dilute the digestive juices and render their action both weaker and slower. Pure water is the best quencher of thirst, but only a little should be taken at a time, and cold water should not be taken when one is much heated or in a condition of great exhaustion.

A hearty meal should not be taken less than an hour at least before retiring for the night, nor immediately before or immediately after very hard work.

Errors in diet.—**Too much food**, whether due to too large or to too frequent meals, throws undue work upon the digestive organs, which are kept constantly at work and are yet unable to digest the whole of the food eaten. The result is that much of the food passes away by the bowel quite

undigested ; the digestive organs become clogged and weakened in their action ; dyspepsia and constipation usually follow.

Too little food means that the worn out tissues are not replaced. There is consequently loss of flesh, decrease of force and energy, poorness of blood, weakness or inactivity of mind, and eventually a general breakdown.

Too much or too little of any of the kinds of food is also bad. Thus too much fat, while it may lead to stoutness, brings about weakness of the stomach and muscles. Too much starchy food given to infants is the main cause of weak leg-bones and "rickets." Continued deficiency of the mineral salts and vegetable acids causes a poorness of blood which brings on scurvy and other diseases.

CHAPTER IV.

THE PROPER CARE OF THE BODY.

The greatest earthly possession which any of us can desire is summed up in the Latin expression—

"Mens sana in corpore sano"—

"A sound mind in a healthy body." To most people, health of mind and body is their only wealth. It is upon their bodily health and skill that they depend for a living and for the ordinary comforts and pleasures of life. The rich man with broken health does not enjoy life so well as the poor and hard working but healthy labourer. It is therefore of the greatest importance that all should know how to take proper care of the body, and should give strict obedience to the **Laws of Health**.

Sickness or disease is the opposite of health, and it is brought about in various ways.

- (1) **A child may be born diseased.** If his parents are diseased, in all likelihood the child will be as bad or perhaps worse. His health—good health or bad—is the surest of all legacies passed on from parent to child.
- (2) **Disease may come as a result of ignorance of the laws of health or of neglect of attention to them.** Certain matters must be known and attended to if we are to keep our bodies in a state of health. Among these are proper

food and drink, temperance, cleanliness, suitable clothing, thorough ventilation of our houses, regular exercise in the open air, good and regular habits of life.

- (3) **Certain occupations classed as "dangerous" are prejudicial to health.** Among these are working underground, making of matches, certain chemical trades and such like. These cannot be got rid of, but efforts are now being made to counteract their evil effects as far as possible. Care, attention, and common sense on the part of the workers will also tend to reduce the unhealthy influences of such occupations.
- (4) **Intemperance and foolish pleasures are a chief source of disease.** From drunkenness and vice thousands die every year, and the misery caused to themselves during life, and to those associated with them, is incalculable.
- (5) **Disease may be communicated by a diseased person to another person.** Many of the most dangerous diseases are now believed to be caused by minute organisms which multiply in the diseased person and are given off into the air from his body. They may also find their way into food, drinking water, milk, etc. and thus are enabled to attack other persons. The chief safeguard against these germs of disease is thorough cleanliness in our persons, our clothing, and our homes and much exercise in the open air, so that the body may be kept in a good state of general health.

In striving to keep the body in a good state of health and thus enabling it to repel the attacks of disease, the most important point for young people to attend to is the early formation of **good and regular habits**. Bad habits are the commonest cause of bad health in the individual and of the spread of disease in the community. For not only does the person who contracts bad habits suffer in health and become less fit to take his part in the work of the world but all who are associated with him suffer also to a greater or less extent. On the contrary, good and regular habits invariably tend to promote health and happiness and to sweeten and lengthen life.

1. **Eating and Drinking.**—Most people constantly eat and drink too much from mere habit. As has been already pointed out a sufficiency of food is a necessity, but it is certain that

more people suffer from eating too much than from eating too little. **Too much animal food** produces a state of body in which the blood-vessels are overloaded, the brain and the nervous system are clogged, and the result is mental sluggishness and physical inability for exertion. **Too much non-nitrogenous food** produces corpulence and indigestion. In both cases the body is less prepared for the inroads of disease and less likely to overcome the attacks of illness.

Food should as far as possible be taken **at regular times**. It should be **eaten slowly and carefully and properly chewed**. If food is so taken the amount of any diet can usually be regulated with safety by the appetite.

The best drink for quenching thirst is undoubtedly **pure water**. It is a mistake, however, to drink much water at a time; and some people get into the bad habit of drinking water too frequently. Young people should also remember that it is very dangerous to drink cold water when the body has become much heated (after running, etc.) or much exhausted (after hard work).

Tea as a drink is both refreshing and invigorating. It stimulates and tones the nervous system and tends to remove the feeling of drowsiness. It must not, however, be too long infused, otherwise its usefulness is destroyed owing to the presence of tannin which hinders digestion. It is a bad habit to take tea frequently. Tea is not a food in any sense, and should not be used as a food. The excessive use of tea is by no means uncommon, and is followed by loss of appetite, indigestion, paleness, and poverty of blood. Tea should not be taken fasting but is best taken at the end of a meal. It should not be sipped with every mouthful of food, as the tendency is to wash down the food without proper chewing.

Coffee contains a certain amount of fat, and **Cocoa** fat, albumin, and starch. They are thus foods as well as stimulating and nourishing drinks.

Alcoholic drinks should be entirely avoided by young people. While to the old and the weak they may be of service under certain circumstances, they are not only unnecessary but positively harmful to the young and the strong. In this matter the formation of habit is of great importance. The evil effects produced by intemperate habits are well known.

Alcohol.—Wine, beer, spirits, if taken to excess have a harmful effect upon many parts of the body.

a. The Stomach and Digestion.—The gastric juice is at first increased in quantity, but becomes eventually much poorer in quality and thus less able to dissolve the foods. The walls of the stomach are inflamed. Some classes of food, as meat and eggs, are rendered harder and more difficult of digestion by the presence of alcohol.

b. The Liver.—The liver acts as a filter for the blood before it is carried into the general circulation. Alcohol irritates, inflames, and at length hardens the liver, which is thus unable to perform its functions. The blood is then distributed throughout the body in a less pure condition, causing disease in various parts. The red corpuscles are weaker and consequently unable to take up the necessary amount of oxygen.

c. The Lungs.—Long continued use of alcohol impedes respiration and is believed to be the cause of some forms of consumption—that is, weakening and consequent destruction of the substance of the lung.

d. The Heart and Blood-vessels.—The first effect of alcohol upon the heart is to cause it to beat more quickly, but when this passes off the beat becomes much slower and weaker than the normal, and after excessive doses it may stop altogether as in poisoning by alcohol. The blood-vessels become relaxed and a larger quantity of blood is forced through them. The result is seen in the inflamed face and bloodshot eyes of the habitual drunkard.

This is a most serious matter, because in cases of extreme illness it is often desirable to stimulate the action of the heart, and the doctor prescribes doses of alcohol, say brandy and water. Where, however, alcohol has been habitually taken the heart gradually ceases to respond to the stimulant and this valuable remedy is useless.

e. The Muscles.—At first alcohol seems, by its exciting the heart, to give greater force. It has been found, however, that for prolonged exercise or heavy work, alcohol instead of being helpful is the exact opposite.

f. The Skin and Kidneys.—The skin is stimulated at first but soon becomes depressed, loses its healthy colour, and is less readily healed if hurt. Alcohol inflames the

kidneys which are less able to withdraw water and waste matters from the blood. Consequently these pass into circulation, diluting the blood and causing it to be less pure and nourishing.

g. The Brain and Nervous System.—Excitement, loss of sensation and will power, of memory, and even of reason are the common results of indulgence in alcohol. It is said that 35% to 40% of all cases of insanity can be traced to the effects of alcoholic drink. In addition, poverty and misery, loss of character, and crime of all kinds are in a very large measure due to over-indulgence in alcohol.

2. **Smoking** tobacco by boys is another bad and exceedingly harmful habit. To men who are grown up and whose bodies are fully formed, smoking in moderation may do little harm, but in all cases excessive smoking hurts the digestion, the nervous system, the mouth and lips, and even the sight. Smoking among boys hinders the growth of the body, spoils digestion, dwarfs the brain, wrecks the nervous system, and produces poor, puny, half-developed men.

3. Recreation, Exercise, Rest, and Sleep.

Recreation means the renewal of the powers of body or mind after they have become exhausted by work. It is entirely different from rest. Recreation is an entering into some form of activity which provides an entire change from ordinary work; rest is abstaining from all activity. Some form of recreation is necessary for the continuance of a healthy tone both of mind and body. It may be found in the reading-room, in music, walking, cycling, gardening, cricket, or other outdoor game, chess, or other indoor game, in amateur work of any kind, as fret-cutting, or in any "hobby." The form of recreation preferred will of course depend upon the tastes of the person as well as upon the nature of his daily work. It should be of a kind quite different from his ordinary duties, providing if possible change of scene, of air, and of ideas. It should also serve some useful end, as strengthening the body or improving the mind, or producing articles of beauty and utility. The inside worker should take his recreation in the open air. The bodily worker may well enjoy some form of mental recreation. Recreation must be taken in moderation, and

should never be carried so far as to become a toil or a weariness, for then it ceases to be recreation and becomes work. Above all, we must see that our recreation, whatever form it takes, is kept pure and elevating, and not allowed to develop into anything that is vulgar or rude.

Exercise in the open air is one of the best forms of recreation for all. It is indeed one of the chief conditions of continued health. Such exercise should be taken **daily** by every one. The muscles when duly exercised become harder and stronger and more responsive to the will. The lung power and the circulation, the digestion, and the action of the skin are increased, and the whole body is benefited. Care should, however, be taken that the exercise is not too severe or prolonged, in which case serious harm would result. Sudden and violent exertions of any kind should not be rashly made. For great exertion a long and careful training is necessary.

Rest and Sleep.—Regular periods of rest and sleep are also essential to continued health, as in this way the exhausted powers of body and mind are best recruited. The amount of sleep required varies greatly with different persons and with different periods of life. Infants spend the greater part of the day in sleep; young children require at least twelve hours of sleep out of the twenty-four; older boys and girls should have nine or ten hours of sleep daily; and adults need not less than from six to eight hours. It is good to form regular habits as to the hours of retiring at night and rising in the morning. In such a case sleep is sounder and more refreshing than when it is taken at irregular intervals.

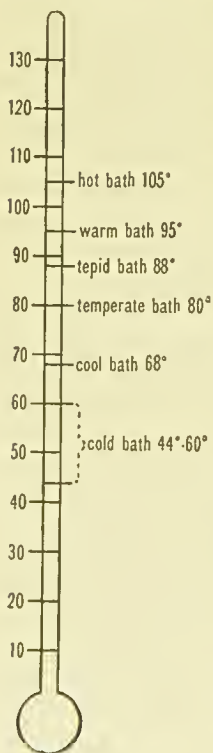
It is not good to sleep on or too near the floor. **Beds and bedsteads** should be used wherever possible, and bedsteads are better without curtains. During the night **fresh air** is required as much as during the day, hence it is advisable to sleep with the bedroom window opened in such a way as not to cause a draught. Children often require to be warned against the bad habit of **covering up the head** with the bedclothes, this interfering with the free breathing of fresh air. Everything about the bedroom, the bedstead and the bedclothes should be kept **scrupulously clean**. A dirty or ill-ventilated bedroom and dirty bed linen are certain causes of impaired health.

4. **Cleanliness.**—Young people should early acquire the habit of strict cleanliness both in **person** and in **clothing**. If the perspiration, the oil, and the decaying scales of the skin are not washed off regularly they unite with the dust to clog the sweat glands. The perspiration is thus unable to find its way to the surface. As a consequence **the action of the skin is more or less stopped**, and additional work is thrown on the lungs and the kidneys, which soon become diseased from overwork. The **unpleasant smell** from a habitually dirty skin is caused by the decay and putrefaction of the oil left on the surface.

Regular washing and bathing, not of the hands and face only, but of **the whole body** is one of the best aids to sound health. It is besides an excellent **tonic** for the skin and its nerves, and in some circumstances has a **soothing effect** upon the nervous system. At least once a week the whole body should be washed thoroughly with

tepid water and soap. It is a good habit every morning to **sponge down** the skin with cold water, or in frosty weather with water the sharp edge of which has just been removed by the addition of a little hot water. This should be followed by a thorough **rubbing with a dry rough towel**. Those who thus “sponge down” every morning are much less liable to take cold.

Baths.—As regards their temperature baths are classified as cold, cool, temperate, tepid, warm and hot. The average temperature of each is indicated in the accompanying figure.



THERMOMETER.

The **Cold Bath** (44° – 60° varying with the season and the weather), if not too long continued, acts as a tonic and exhilarant, and eventually increases the temperature of the skin. For those with whom it agrees nothing could be more refreshing and stimulating. If it has not the effect of producing “a glow” of heat it is hurtful and should not be taken. Some persons in perfectly sound health cannot safely take a cold bath. If the skin remains chilled,

the fingers and lips become blue, and the face pale after a cold bath, it should not be persevered with. It is not as a rule suitable for the very young or the very old, or for the nervous or those of weak circulation.

Similar remarks apply to the use of the **cool bath**.

Temperate and tepid baths are most generally applicable for purposes of cleanliness and should be taken once a week. They relax and purify the skin and promote insensible perspiration.

After fatigue from travelling, etc. the tepid bath is grateful and refreshing, and it is helpful and healing in cases of irritated nerves, and dry or chafed skin.

Warm and hot baths are not suitable for general use and should only be employed as remedial agencies, as in cases of skin troubles, etc. Persons who are not in good health should not risk such baths unless under medical advice.

The **regulation of the temperature** of a bath should not be left to the sensations but should always be decided by a thermometer. This is the only true test, and as a thermometer can be had for a few pence no family should be without one.

Sea bathing is very stimulating, but should not be indulged in immediately after a meal, should not be too prolonged, and should be followed by a thorough rub down and some brisk exercise.

The **mouth** should be washed out and the **teeth** brushed at least twice a day. This latter tends to preserve the teeth from decay.

The **hair**, too, should have some attention, being kept neat, clean, and well combed and brushed.

Another important matter is attention to the **finger and toe nails**. These should not be allowed to grow too long or to have dark rings of dirt along their edges. It is better not to cut them with knife or scissors, but to keep them in good order by regular filing. The bad habit of biting finger nails should be carefully avoided.

Cleanliness in clothing also largely conduces to health. The underclothing should be regularly washed to remove the oil and sweat, which otherwise will putrefy and cause an unpleasant smell. The outer clothing can always be kept whole with a little attention, and should be carefully brushed at least once a day.

5. The nature of the clothing we wear has also a considerable bearing upon our health.—Clothing, besides being an adornment, is worn as a **protection** against cold, wet, and injury from without. Some substances conduct heat from the body more quickly than others. Closely woven linen and cotton, being good conductors of heat, are not suited for warm clothing next the skin; while wool and fur, and loosely meshed linen and cotton, being bad conductors, may be worn next the skin as they will not readily conduct the heat of the body away. Generally speaking a **bad conductor** of heat should be worn next the skin except in very warm weather. The outer garments should be varied according to the season, so as to give sufficient protection from cold. Clothing, while sufficiently warm, should not be heavy, and it should be close-fitting, but not so as to impede free movement. **Tight clothes** round the neck, the chest, the arms or legs are specially harmful. They prevent the free action of the lungs or the heart and circulation. Tight lacing around the waist is apt to displace the heart and the liver, and thus seriously injure the health. During active exercise especially the clothing should be worn loosely, and particularly that around the neck.

6. **Materials of Clothing.**—We derive the materials of our clothing from both the vegetable kingdom (as cotton and linen) and the animal kingdoms (as fur, wool, leather, silk).

Cotton is the downy fibre or hair of the seed pod of a plant which grows in America, India, Egypt, etc. It is cleared of the seeds and other impurities by machinery. The fibres are then arranged to lie in one way by means of the carding machine. After being drawn out lengthwise they are spun (twisted) to form yarns, and the yarns are again spun to form thread. The threads are now woven into various fabrics which finally undergo the processes known as bleaching and finishing. In bleaching, the natural yellowish colour of the cotton is removed by means of chemicals, while finishing includes mangling, starching, and the application of various materials which give greater weight and a smoother surface.

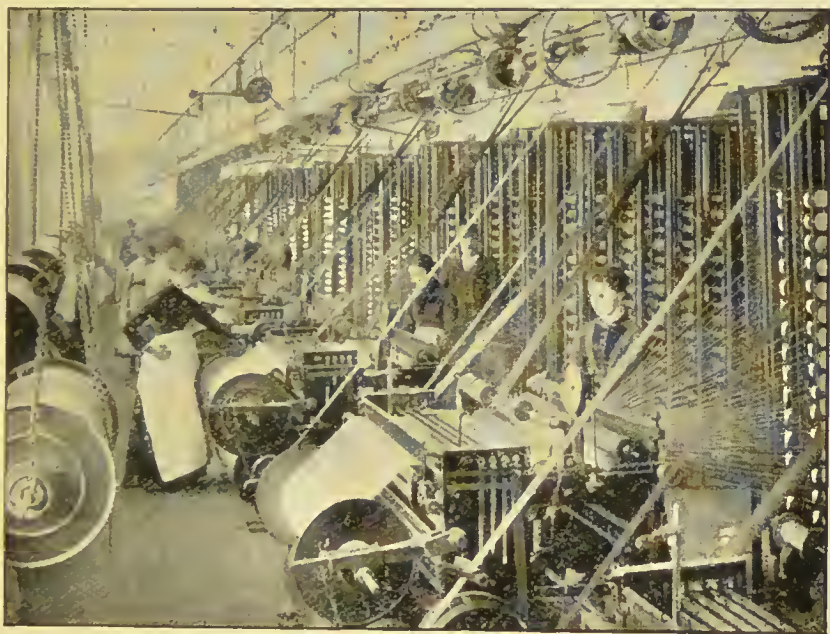
Calico (plain or printed), sheeting, towelling, flannelette and velveteen are made from cotton. Merino is made from a mixture of cotton and wool.

Cotton is a good conductor of heat and does not absorb moisture readily, hence it is not suitable for wearing next the

skin. It is, however, very durable and does not shrink when washed.

Linen is made from the fibres in the stem of the flax plant, which grows in Russia and other continental countries, in Egypt, in India, and also in Ireland. After being heckled (or carded) and spun it is generally bleached before being woven into a variety of linen goods (as sheeting, towelling, sailcloth, diaper, damask, cambric, lawn).

Linen also is a good conductor of heat and a bad absorber of moisture, and, unless in cellular form (woven with open



IN A LINEN MILL, BELFAST: Warping.

meshes, which being filled with air lessen its power of conducting heat from the body) is not suitable for wearing next to the skin.

The linen fibre is stronger than cotton, and linen goods are much more expensive than fabrics made from cotton.

Among other clothing materials derived from the vegetable kingdom **indiarubber** takes a place, chiefly on account of its being impermeable to water. Cotton or silk fabrics treated to a solution or paste of indiarubber form the cloth known as Macintosh, much used for waterproof coats, cloaks, etc.

Wool is the principal material of clothing derived from animals. It is obtained from sheep, goats, etc. After being cleaned and freed from its natural oil it is carded, spun, dyed in various colours, and woven to form a very large variety of fabrics. Among these are cloth (tweeds, etc.), flannel, blankets, serge, felt (for hats), velvet, knitting wools, etc. Alpaca is a fine wool got from a Peruvian animal and used in the manufacture of umbrella covers, shawls, etc. Cashmere is a still finer wool (and very scarce) obtained from the goat of Tibet. The wool of another goat is known as mohair.

Wool conducts heat badly and absorbs moisture readily. It is accordingly generally employed for underclothing. Unless very great care is exercised in the washing of woollen goods they are liable to shrink and to become hard on the surface.

Fur is obtained from various animals, chiefly the bear, seal, otter, chinchilla, fox, sable, ermine, etc. Fur is one of the most perfect non-conductors of heat, and if properly prepared makes the most comfortable outer clothing that can be worn in cold climates. Some furs (as those of the hare, rabbit, beaver, etc.) are very suitable for making into felt.

Leather is the skin of animals of various kinds from which the hair or fur has been removed, and which has been suitably prepared by tanning or otherwise so as to remain tough and yet soft and pliable. The skins of the ox, horse, sheep, goat, and deer are commonly made into leather, from which we have such articles of clothing as boots, leggings, belts, gloves, etc.

Silk is a strong fibre spun by the caterpillar of certain moths. These caterpillars are known as silkworms and are extensively cultivated on the Continent, especially in France, and in China, Japan, India, etc. The silken thread obtained from one cocoon averages 300 to 500 yards long, and 12 lbs. of cocoons yield about 1 lb. of raw silk. Silk is a bad conductor of heat and a very good absorber of moisture. It is thus suitable for underclothing, but its costliness prevents its ordinary use for this purpose. It is manufactured into silks, ribbons, satins, plush, velvet, crape, etc. It is often added to woollen goods to impart lustre.

Feathers are mainly employed for purposes of adornment, but are also used to stuff pillows and beds, and as boas are worn around the neck.

7. To ensure our own health and the health of those who live with us there are some matters connected with our **dwelling houses** deserving of attention.

- (1) **Living rooms** are most cheerful when they face the south or west as they receive most sunlight, and nothing is so certain a destroyer of germs of disease as sunlight and fresh air together with cleanliness.
- (2) **Bedrooms** facing east or north-east are very cheerful, as they receive the early morning sunlight.
- (3) Houses in **narrow streets and lanes** should if possible be avoided, as there is a deficiency of fresh air in such localities. A house which is usually **damp** is not fit for occupation.
- (4) There must be **strict cleanliness** throughout all the house, and a **thorough daily ventilation** of every room.
- (5) It is of vital importance to the dwellers that all **water closets and drains** should be properly constructed and trapped to prevent the entry of sewage gas to the house.
- (6) In the matter of **heating** a dwelling house the **open fire-place** is perhaps the best method, as it helps very materially in the ventilation, although it is not an economical plan. It is as great an error, and quite as harmful to health to keep a house too warm as it is not to have it warm enough.

CHAPTER V.

VENTILATION, HEATING, AND LIGHTING.

These subjects can best be taken together, as methods of ventilation have to be modified according to the methods of heating and of lighting employed.

The **objects of ventilation** are

- (1) to provide for the escape or removal from an enclosed space of air which has become deteriorated from any cause, and specially from the respiration of human beings or animals ;
- (2) to introduce fresh and pure air to take the place of the impure or deteriorated air removed.

Air Space required.—An inhabited room becomes close or “stuffy” and consequently unhealthy when the carbonic acid gas present in the air of the room exceeds that contained in the open air by 2 parts per 10,000. To prevent this the air in the room must be changed. If the room is small the air must be changed oftener than in the case of a larger room. It has been found that with people sitting in a room it is unsafe to change the air more than three or four times per hour unless the fresh air introduced has been specially heated. Quicker change invariably causes draughts, producing colds and other illnesses. As each grown-up person requires something like 3000 cubic feet of air per hour, it will be understood that from 750 to 1000 cubic feet of space is required in a room for each adult occupying it, assuming that the air is changed four times hourly. Less space is, of course, necessary per head for children, and much more in sick-rooms and hospitals.

Overcrowding. When the space available per head is very much less than 750 cubic feet, the room is said to be overerowed. Usually, in practice, a lodging-house is declared “overerowed” if there is less than 300 cubic feet per head. In schools where the air is frequently renewed, and where the children are sent to the playground at regular intervals, from 100 to 120 cubic feet per child is considered sufficient. Great care is, however, required in such cases to see that the renewal of the air is regularly attended to. Wherever there is overcrowding it is found that the average standard of health is seriously lowered; epidemic and infectious diseases are more likely to originate, and they spread with greater rapidity, and the death rate is very much higher.

Test for the presence of Carbonic Acid Gas in excess. There are various methods of testing the air of a room, but many of them are elaborate and require special skill on the part of the experimenter. The following method is simple and certain. Take a wide-mouthed jar with a close-fitting lid or stopper. To fill it with the air of the room stuff loosely into it a piece of clean linen and then quickly pull it out. Get some clear lime-water and pour it into the jar to the depth of an inch and a half. Close the jar and shake up the lime-water for a minute or two.

If it becomes milky it indicates the presence of carbonic acid gas to excess, and the air may be described as unfit to be breathed. If the lime water remains quite clear the atmosphere of the room is sufficiently free from carbonic acid gas. Other impurities in the air of a room can be satisfactorily tested only by an expert.

Temperature of Air of a Room.—The temperature of the air of a room has also a large bearing on the health of its inmates. To ascertain the temperature of a room a thermometer should always be employed, as the sensations of the persons in the room cannot be relied upon. The thermometer should be fixed in a position where it will be shielded from direct rays of heat as well as from draughts. The average temperature of an inhabited room should if possible range between 55° and 60° F. Nurseries, sick-rooms, and such like will of course have special consideration, and may be kept warmer. In hot weather it may be desirable to cool the fresh air which is admitted, and in winter to warm it.

Moisture in the Air.—Fresh air always contains a certain amount of watery vapour. The amount present at any particular time depends partly upon the weather and varies also with the temperature. The warmer the air is the more moisture can it contain. It is essential to health that the air of a room should not be too dry (as it might become with some methods of heating). On the other hand, as the air breathed out contains much moisture, the atmosphere of a room soon becomes laden with watery vapour unless it is changed sufficiently often. In such a case the moisture is deposited as water on the walls and furniture of the room, and the atmosphere is detrimental to the health of the inmates.

Methods of Ventilating.—The methods employed for ventilating are very numerous and differ widely, but may be spoken of as (1) **natural** and (2) **artificial**.

Natural ventilation is that which is effected without the use of apparatus (such as a fan) to drive or draw the air in any particular direction, and depends mainly on the general movements of the wind and on changes in the weight of bodies of air due to variations in temperature. As a rule the air of an inhabited room becomes warmer

than the air outside. Warm air is lighter than cold air, and consequently rises into the upper part of the room. The cold and heavier air will come in by any opening near the floor, as under a door. Consequently it would seem as if an opening should be made near the ceiling to permit of the escape of the warm and impure air, and another opening near the floor to admit the colder and pure air.

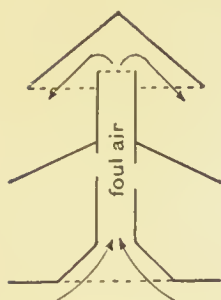
It would be found, however, that this plan, while it might ventilate the room would cause unpleasant **draughts**. These are avoided if an upward direction is given to the current of cold air entering the room. The cold air finding its way upwards towards the ceiling becomes mixed with the warm air and is thus itself warmed. By this method the impure air is being constantly diluted and is thus rendered less harmful.

The best method of ventilating a room is probably by means of **open windows and doors**. If, however, the room is constantly occupied, care must be taken to avoid draughts. Thus it is better to open the upper sash of a window than the lower. Better still is the contrivance of raising the lower sash a few inches and inserting a piece of wood to fit the opening so that no air can enter under the lower sash. The air then enters between the sashes and is given an upward direction by the top rail of the lower sash.

In schools and churches the same object is attained by having a part of the window to open inwards and form an angle of 30° to 45° . Other similar contrivances are **Tobin tubes**, which consist of a horizontal hole through the wall pretty low down communicating with a vertical tube against the wall, which thus gives the air an upward direction, and **Louvre panes**, which consist of strips of glass arranged like the slats of a Venetian blind and drive the incoming air upward. Some of these are fixed in frames and may be opened and closed as Venetian blinds are.

Somewhat similar is the method of glazing one or more panes in a window with two pieces of glass which overlap and leave an opening through which the fresh air can enter.

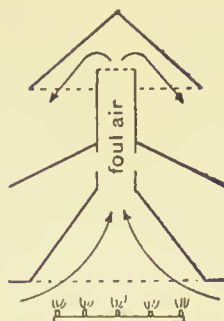
In ordinary dwelling rooms the foul air is got rid of by means of the chimney, and if a fire is burning this is usually satisfactorily accomplished. If there is no chimney there should be an opening of some kind near



Roof ventilating shaft



Louvre Panes



Ventilation aided by roof lights



Glass pane opening inwards



Raised sash with block of wood



Tobin Tube



Overlapping glass panes

the ceiling. In large halls there are often ventilating shafts passing completely through the roof to the open air.

Artificial ventilation may be carried out either by extracting the foul air by means of machinery and allowing fresh air to enter by means of windows, tubes, etc., or fresh air may be driven in by means of the machinery and the foul air allowed to escape by flues or shafts at the top of the building. In each case the movement is effected by a fan driven at a great speed by a gas or other engine. The expense of such ventilation is considerable, and its use is restricted to large buildings such as schools, churches, hospitals, etc.

In the latter case the air being propelled into the building can be filtered through canvas to free it from dust and soot, and it can be dried or moistened, heated or cooled as required before entering the rooms of the building. The amount of air driven into any room can also usually

be controlled by a system of opening or shutting the tubes by which it enters.

Heating.—The common methods of heating the air of a room are (1) by open fires, (2) by closed fires or stoves, (3) by pipes containing hot water, steam, or hot air.

Open fires are the least economical method of heating and by no means the most effective. With an open fire a room if of any size is very unequally heated. Besides, by far the larger part of the heat produced by the burning coal or wood is entirely lost as it passes up the chimney with the smoke, which consists mainly of unburned portions of the fuel. Open fires are, however, very cheerful in a room and aid materially in ensuring thorough ventilation.

Closed fires or stoves. These are usually constructed of iron with a draught hole under the fire to supply the necessary air and a flue or tube communicating with the outside air to carry off the gases produced. Coke is the fuel generally employed. Stoves are more economical as heaters, but have these disadvantages: the air of the room is apt to become unpleasantly dry unless an open vessel of water is kept beside the stove; when a stove becomes much heated the organic matter in the air of the room is charred and gives an unpleasant smell; poisonous gases, the products of the combustion of the coke, often find their way into the room by means of leaking fittings, etc.

Heating by Pipes.—This method is applicable only to large houses, schools, hotels, churches, etc. The boiler is placed in the lower part of the building, and from its upper part a pipe leads the heated water all round the building, returning and entering the boiler by its lower part. The movement of the water depends on the fact that water when heated expands, becomes lighter, and is forced upwards by the colder and heavier water below.

Steam Pipes may also be employed but are not so commonly met with.

Hot Air is also used as a heating agent, and is usually associated with the ventilation of a building. The fan draws in fresh cold air into the basement. This air is heated by being made to pass over pipes which contain hot water and is then carried from the basement into the various rooms by means of tubes. This system is necessarily very expensive but is very effective as a combination of heating and ventilating.

Lighting.—It is a well-established fact that a free supply of sunlight in our homes is almost as necessary to health as fresh air or pure water. Those who live in badly-lit houses never attain a high standard of health and are very susceptible to infectious diseases. Children born and brought up in such homes are pale and weakly, and are frequently subject to scrofula, consumption or rickets.

Care should accordingly be taken that all dwelling houses have an abundant supply of daylight. Blinds and curtains should not be permitted to exclude the sunlight which is perhaps one of the best germicides we possess, besides being a powerful and healthful stimulant. Indeed medical men are now taking advantage of sunlight as a curative agent to a large extent. Exercise in the open air which is recommended as a great aid to health, combines not only the exercise of the muscles and the breathing of pure air, but also depends for its efficacy to some extent at least upon the beneficial influence of the sunlight.

Artificial Lighting.—The artificial lighting of a room has often a very great deal to do with its good or bad ventilation. Leaving out of account the **electric light**, which does not in any way foul the air and has very little effect in heating it, the commoner methods of lighting are by means of **candles, oil lamps, and coal gas**. These all contain both carbon and hydrogen, which when they are burned unite with the oxygen of the air, and thus withdraw from the air its life-supporting constituent. Besides, the carbon forms with the oxygen carbonic acid gas and a still more poisonous compound known as carbonic oxide gas, thus tending to poison the air. The hydrogen combining with the oxygen forms water. In addition if the combustion is not perfect, particles of unburned carbon escape in the form of soot. Fatty matters are also given off from candles and from some oils. From the burning of gas also many other harmful products, as sulphuric acid, find their way into the atmosphere of a room.

It will be evident, then, that the ventilation of a room should receive **more attention** when it is artificially lighted than during the day, so that these harmful products may be got rid of. Unfortunately many people forget this, and when the lamp or gas is lit at night, windows which have been open all day are closed.

It should be remembered that two or three candles or one oil lamp will use as much oxygen and give out as much carbonic acid gas as a man, while one gas burner is in this respect equal to at least three men.

In halls and churches, the lights are sometimes used as **aids to ventilation**, being placed immediately under a flue which communicates with the outside air, and by which the heated air and the products of combustion escape.

CHAPTER VI.

DRAINAGE: INCLUDING REMOVAL OF REFUSE.

Drainage is the process by which superfluous moisture is removed from the soil, through the soil itself, or by means of channels made in or through the earth. A **drain** properly speaking is that which **draws** the superfluous water out of the land and thus removes the wetness and dries the subsoil. In the Public Health Act, however, a "drain" is also taken to mean "a branch sewer connecting houses with the main sewer." Hence it is that the subject *drainage* usually includes the subject *sewage*, or removal of waste matters from houses, etc.

Necessity for thorough drainage.—It is a matter of common observation that a district which is naturally well drained (by rivers, or a porous subsoil) is always healthier than a district where moisture accumulates. In the latter case various diseases, especially **fevers and affections of the throat and lungs**, are apt to prevail. The proper removal of all waste matters is absolutely **necessary to health**. In every house, a large amount of waste matter is produced daily in the form of animal and vegetable remains of various kinds, the liquids used for washing and cooking, ashes, dust, etc. If such are kept in or about houses, they speedily decompose and poison the atmosphere. If kept in heaps on the ground foul matters from them find their way into the soil, which becomes sodden, and perhaps into wells, rendering the water unfit for drinking. The result is that in such a place enteric (or typhoid) fever, cholera, diphtheria and other dangerous diseases are prevalent, and even where such diseases are not present the general health of the community is low and the death-rate high.

A thorough system of drainage (including the removal of such waste matters) aims at **the speedy removal** of all superfluous moisture and of all waste matters to a safe distance from dwelling houses.

This double removal may be carried out on the **combined system**, where rainfall and sewage are conveyed away in one set of pipes, or on a **separate system** on the principle of sending "the rain to the river and the sewage to the soil."

In country districts and in towns remote from the sea the latter system is of necessity the commoner, but in large towns in this country the former system is almost universal.

METHODS OF REMOVAL OF REFUSE.

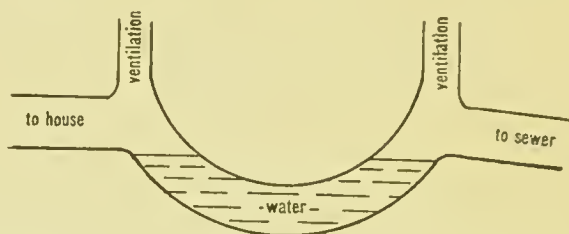
1. **When the sewage is applied directly to the land.** It is found by experiment that this plan works well in isolated districts, and yields some return in the form of vegetables, grass, etc. Unless the soil be a clay it has, if well underdrained, almost unlimited power of cleansing any foul liquid that may enter or pass through it. Indeed one acre of ground is sufficient for the sewage from a hundred persons if it is well distributed over it. The surface is ridged and furrowed, and the sewage is run into the furrows, while cabbages etc. are grown on the ridges. The ground selected for this purpose should, however, be at some distance from dwelling houses—not less than a quarter of a mile.

Where the ground available is of smaller extent, an **intermittent system** is adopted. The ground is divided into four parts, which receive the sewage alternately for six hours.

Where **cess pools** are employed to collect liquid and other refuse they should be placed at least fifty feet from the house, and much further from any well or spring. The contents must be regularly removed and may be spread over the fields or gardens as manure.

2. **Where sewage is carried to the sea:**—In most towns in this country large sewers are built through the streets, and drains from the houses communicate with these. The outlet is under water and is usually carried well out to sea, or to a tidal river or estuary. It is **illegal** to pass sewage into inland rivers until it has been "purified by the best practical and available means." The common sewers must be properly **ventilated** and should be supplied with "**man-holes**" at regular intervals to allow a man to descend and remove any

obstacles to the flow. Between the house drain and the common sewer, there should be a "**trap**" with ventilation on both sides. A trap is a bend in the drain pipe which permits liquids and solids to pass through, but prevents the passage of the foul gases from the sewer. The ventilator on the side of the sewer permits of the escape of sewer gas; that on the side of the house allows the entrance of fresh air into the house drain.



SEWER TRAP.

3. **Scientific methods of purifying sewage.**—Many methods have been proposed and carried out with more or less success. Chemical methods mainly aim at **precipitating** (or throwing down) organic matters contained in sewage. Quicklime is used for this purpose, six to twelve grains being added for each gallon of sewage. Coarse salts of iron and aluminium are also employed, either alone or in combination with lime, or with clay and charcoal. The matter precipitated is known as **sludge**. When filtered and pressed into cakes it is sold to be ground into powder and used as manure. The remaining liquid after the precipitation of the sludge is still very impure, but may be discharged into a fairly large river without creating a nuisance or filling up the bed of the river.

It has also been proposed to purify sewage by the passage of an **electric current** through it and by subsequent filtering. Recently, too, considerable progress has been made in what might be called **biological methods** of purification, which depend upon the action of the bacteria in the sewage in first liquefying the solids and then oxidizing or nitrifying them. The result is nitrites and nitrates, which are of considerable value as manures.

4. **Disposal of Solid Refuse:**—The simplest and perhaps

the best and safest method of disposing of solid or dry refuse (paper etc.) is to burn it and then bury the remains in trenches in the ground.

House drains in towns.—House drains, if not properly constructed and kept in good order, are a source of danger to the health of the inhabitants.

They should not, if possible, be carried **under any part of the house**, as in the case of leakage the sewage gas will find its way into the rooms. If it is necessary owing to the shape of the site or for any other cause to carry them under the building they should preferably be carried under an open entry and, in any case, when laid they should be enclosed in a thick bed of cement.

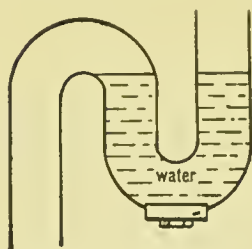
The drain pipes connected with a house are of three kinds : (1) **Soil pipes**, (2) **Waste pipes**, (3) **Rain water pipes**. **Soil pipes** are for the removal of sewage and pass from the water-closets to the drains, which again connect with the sewers in the street. They are made of lead or cast iron and may be carried down either inside the walls or outside the building. It is essential that all joinings of the pipes themselves and their connection with the water-closet should be **air-tight** to prevent the escape of sewer gas into the house. To ensure **ventilation**, the soil pipe should be carried upwards on the outside to a height of several feet above the eaves of the house, in a position where the opening will be some distance from any window or chimney. The house drain must be "**trapped**" at its connection with the sewer.

Waste pipes are for the discharge of water from the sinks in kitchen, scullery, or washhouse, and from lavatories and baths. These should be entirely distinct from and quite unconnected with the soil pipes. Waste pipes should not communicate directly with the house drain but should discharge into a trapped gully. This prevents the entry into them of any gases from the sewer or drains. Waste pipes should also have a siphon trap immediately under the sink or bath as a further safeguard.

Rain water pipes (known in Scotland as *roues*) and conductors should be treated exactly as waste pipes and should not have any direct connection with drain or sewer.

Testing house drains and their connections.—Leaks in soil and other pipes are not of uncommon occurrence and

should at once be put right. To determine the exact position of the leak the best methods are the following:—



SYPHON TRAP.

(1) Pour water charged with oil of peppermint into the pipes at the top of the house. The oil of peppermint gives off so distinct an odour that the position of any leak may be easily discovered.

(2) Fill the drain with smoke from the burning of tarred rope or other similar substance. The smoke will find its way up the soil pipe and can be seen escaping into the house through any leak.

To keep drains in good order, they should be frequently flushed with water or with water containing some disinfectant (see page 60) in solution. Care should be taken that nothing is put down the soil pipe which might block it up. When a stoppage occurs in this way it may be a troublesome matter to remove the obstacle, requiring the attention of a skilled tradesman.

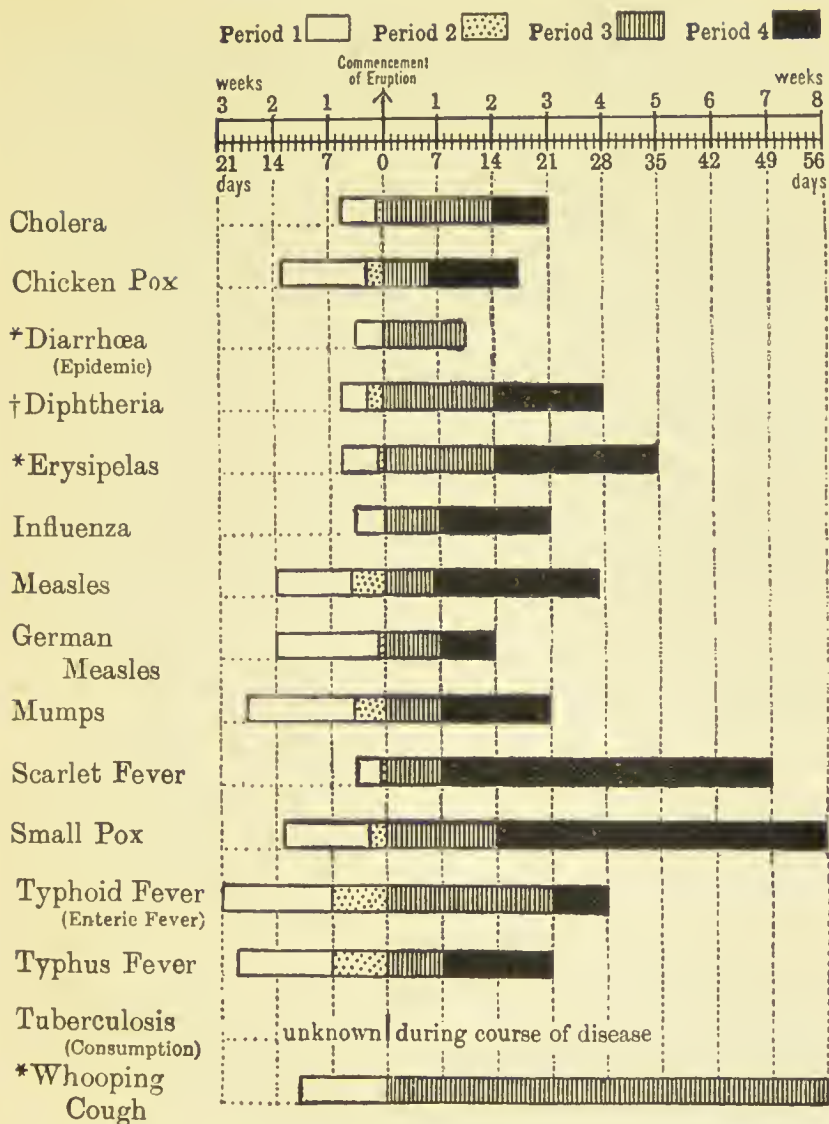
CHAPTER VII.

THE SPREAD OF DISEASE.

It is now well known that some of our commoner diseases are caused by the entrance into the body from without of certain living cells of the nature of poisons or ferments, which are variously referred to as microbes, micro-organisms, bacteria, or simply germs. Having entered the body, if they find there a suitable "soil" they are able to grow and to multiply enormously. Then the person into whose body they have entered suffers from the special form of disease. But this is not all. The germs are again given off from the diseased body, and thus it is that these diseases may be communicated from one person to another. Such diseases are said to be infectious, and include:—

cholera	influenza	typhoid fever
chicken-pox	measles	typhus fever
diarrhœa	mumps	tuberculosis
diphtheria	scarlet fever	whooping cough
erysipelas	small-pox	

In such diseases there are usually four distinct periods.



Incubation = Periods 1 and 2.

Fever = Periods 2 and 3.

Possible Infection = Periods 2, 3, and 4.

1. There is the period of **absolute latency** which elapses between the entrance of the infection into the system and the first signs or symptoms of the disease (as sickness, fever, etc.). This is a very important point to know, as when a person has been exposed to infection and the usual

* These vary to a great extent.

† In many cases the period of infection may be described as indefinite.

period of incubation for that disease has passed and no symptoms of illness have appeared, he may congratulate himself on having escaped, and may mix with other people without risk to them. (On this point see also the paragraph on Inoculation on this page).

2. The second period is the **period of Fever**, before the appearance of any rash or eruption on the skin, which, however, does not occur in all the diseases mentioned.

3. Next is the **period of Eruption**, which may be taken to include all "rashes" on the skin, swellings, and coughing.

4. Lastly is the **period of Infectiveness** after the eruption has disappeared.

The Table on page 57 shows in a graphic way the **average** or **normal** duration of each period.

The following symptoms, though not infallibly indicating the advent of the particular disease, afford **reasonable ground for suspicion**, and especially when an epidemic is present.

Fever is present when the temperature, as indicated by means of a clinical thermometer placed under the tongue, is found to range from 98° to 100° or upwards. If 100° is reached serious disease may be suspected and a doctor should be summoned.

Fever with cold in the head	may indicate	MEASLES.
Fever with sore throat	"	SCARLET FEVER.
Fever with pain in the back	"	{ SMALLPOX or
		{ TYPHUS FEVER.
Fever with headache	"	TYPHUS FEVER.
Fever with headache and diarrhœa	"	TYPHOID FEVER.

A very important point in connection with some of these diseases is that **one attack of a particular disease usually protects the sufferer from a second attack** of the same disease. It is believed that in these cases the blood or the tissues or both undergo a change of such a nature that in future they form an uncongenial soil for the propagation of the germs that give rise to the particular disease.

Vaccination and Protective Inoculation.—The fact that one attack of a particular disease, however mild, usually protects from a second attack is really the principle underlying the practice of vaccination against smallpox. Vaccination is inoculation of the human being with the smallpox poison after it has passed through the body or blood of the calf.

By this means the person vaccinated has the disease in a very modified form, and is rendered for a time at least insusceptible or much less susceptible of the true smallpox. It is on exactly the same principle that M. Pasteur introduced the practice of **inoculation against hydrophobia**, a terrible disease resulting from the bite of a mad dog. In this case the poison is passed through the body or blood of the rabbit and forms what may be termed a protective substance against true hydrophobia. Fortunately hydrophobia takes a very long time—sometimes months—to develop in the human body, and if the person bitten is inoculated with the protective substance before the germs of the disease have been able to propagate, the true disease may usually be warded off.

Medical men look forward to great developments in this method of treating other diseases, and already it has been highly successful in the treatment of diphtheria and tetanus (lockjaw).

The Prevention of Infection.—Infection may be spread in a very large variety of ways. **Actual contact** with the diseased person or with his clothes, etc. is a likely way, and those who are tending on the sick should be specially careful. Strict cleanliness, especially of the hands, is very necessary. Again infection may be carried in the air in the form of **microbes** or **spores**. Certain diseases are very readily spread by means of **food and drink**, especially milk and water, in this case the poison of the disease being swallowed.

To minimise as far as possible the spread of disease the patient suffering from an infectious disease should be **isolated**. Unless a flat or a detached room can be used for this purpose, the patient should be removed to a fever hospital. Here he will get the proper attention and nursing which his case requires, and means will be taken as far as possible to prevent the spread of the disease. When a patient is isolated in his own home, he should have a nurse to attend to his wants, who should not on any account mix with the rest of the family. When any intercourse is necessary the nurse should take off her outer dress in the sick-room, wash her hands and face, and put on a fresh dress kept outside the room or in an adjoining room.

The clothes, cups, plates, etc., used by the fevered person,

should not be mixed or washed with those used by the other members of the house. All discharges from the nose and mouth and from the bowels should be **burned or disinfected**. For this purpose a 5 % solution of carbolic acid or of izal is best. In scarlet fever and smallpox the scales that fall from the skin contain the germs of the disease. In such cases the patient's skin should be washed with warm water and carbolic soap and smeared with carbolic oil.

Disinfection.—The thorough disinfection of a room in which an infectious disease has occurred is very necessary, as the germs of the disease retain their vitality for long periods of time. The paper should be stripped from the walls and ceiling and the whole thoroughly washed with warm water and carbolic soap. All **clothing** of little value used by the patient should be burned. Pillows, etc. to be disinfected should be subjected to the action of **superheated steam**. This will usually be carried out by the sanitary authorities, who have the required apparatus. Where no such means exist, the clothing should be soaked for a whole day in some strong disinfecting liquid, as—

Carbolic acid or izal 5 %, Perechloride of mercury $\frac{1}{10}$ %,

Chloride of zinc $\frac{1}{2}$ %, Formalin, 2 %,

Chloride of lime, 2 oz. to the gallon,

and then boiled and thoroughly seoured, carbolic soap being used.

While there is infectious disease about, the **drains should be frequently flushed**. This should be done with any of the solutions mentioned above, or with carbolic powder or sulphate of iron (green copperas) in the strength of one pound to the gallon.

It should be noted that many of the above disinfectants are **extremely poisonous**, and should therefore be kept in a place where children cannot get at them. They should also be kept in dark coloured and ribbed bottles so that one handling them by day or night may at once know that they contain poison.

There is another class of diseases, many of which are extremely **contagious**—that is, they may be transmitted by contact, and include—

ringworm,	thrush,	itch.
scald head,	chloasma,	

These are caused by low forms of vegetable or animal life

which live in or upon the human body and derive their nourishment from it. They are known as **Parasites**.

Of these perhaps the commonest and most troublesome is that known as **Ringworm**. It is caused by the growth on the skin, particularly among the hair, of a **fungus**, a vegetable parasite which spreads regularly in circular form, the inner parts gradually healing. Thus the disease assumes the well-known ring-like form. It is perhaps the most contagious skin disease, being readily transferred from one person to another by means of caps or hats, combs and brushes, towels, gloves, etc. It causes great itch and if scratched may be carried by the finger nails to another part of the body.

In schools this disease is sometimes epidemic, spreading from child to child with alarming rapidity, in all cases by actual contact.

It is of the greatest importance that the first symptoms should be recognised. The skin is scurfy, slightly red, and with irregularly broken hairs protruding. The hairs which are attacked by the fungus must be removed and the fungus can then be destroyed by painting with tincture of iodine or other germicide.

The greatest care must be taken that infected caps, combs and brushes, towels, etc., used by the persons affected, be not used by other people, otherwise the spread of the disease is certain.

Unless of unusual value all such infected articles should be burned.

Scald head is in reality another form of ringworm and indeed the worst form of it. It is characterised by the formation on the scalp of dry, yellowish cup-shaped crusts from which a hair projects. This also is intensely contagious, and very difficult to cure, sometimes continuing for months or even years.

Such cases should be put at once under medical treatment, and means taken to build up the patient's general health.

Thrush is also a vegetable parasite which is found in gray-white patches in the mouth and on the tongue, generally of young children, but also to a limited extent in the case of grown-up people.

It is caused by improper feeding and the use of dirty feeding-bottles. In addition it usually indicates a poor state of health. The mould can be wiped out of the mouth with

a handkerchief and the mouth should then be rinsed out with a solution of chlorate of potash or glycerine and borax. Attention should also be paid to the general health of the child.

Chloasma is another skin disease due to a vegetable parasite. It occurs on the body, especially the chest, in light brown patches, the surface of which is rough and itchy. Usually it is the result of insufficient washing. A thorough daily scrubbing with soft soap and warm water, followed by brisk rubbing with a rough towel, will usually remove the fungus. If necessary this may be followed by treatment with a weak solution of carbolic acid in water.

Itch is caused by an animal parasite—the minute itch insect, which burrows into the skin and there lays its eggs. These are hatched in about a fortnight and again begin burrowing on their own account. In this way the disease is spread. This sets up an intense irritation accompanied by a rash, sometimes with blisters or pustules. The commonest parts affected are between the fingers and toes, but it may be found on other parts of the body. It is extremely contagious, the mere shaking of hands being sufficient to transfer the disease. Although most commonly found on persons of uncleanly habits and poor constitution, it will be seen that it may be caught accidentally by the cleanest and strongest by actual contact with some one affected, or with his clothing.

Sulphur ointment together with thorough scrubbing with warm water and soft soap is the best remedy. The person affected should not be allowed to mix with others. His clothing must be properly disinfected, or if of little value it should be burned.

The best **general safeguards** against the spread of disease of every form are to be found in—

- (1) **Strict cleanliness** of person, clothing, and home;
- (2) **Regular and systematic exercise** in the open air;
- and (3) **Wholesome and properly cooked food.**

Those who attend carefully to these will find that their general health will be improved. They will thus be more able to ward off attacks of disease; and if disease is contracted they will suffer less severely and be able more readily to overcome the attacks.

CHAPTER VIII.

FIRST AID.

By **first aid** to the sick or injured is meant such help as may be given before the arrival of a medical man to those who have met with an accident or who have taken suddenly ill. In all serious cases it is necessary to send at once for a doctor, and until his arrival to do the best for the patient in accordance with the hints given on this and the following pages.

Perhaps the commonest class of cases which can be greatly helped by first aid methods are those where there is considerable loss of blood. Here prompt and well-directed attention may be of the greatest value, even to the extent of saving life.

HÆMORRHAGE OR BLEEDING.

This term is used to indicate the loss of blood as the result of accident or disease. First aid is usually directed towards **arresting the bleeding** if at all severe. In some cases, however, as in poisoned wounds, bleeding is to be encouraged, at least at first.

The nature of the bleeding and consequently the method of arresting it varies according to the kind of blood-vessel damaged.

- (1) **Arterial bleeding.**—When an artery is cut the blood flows in jets and spurts which correspond with the beats of the heart. It comes from the side of the wound nearest the heart, and in colour it is bright scarlet. This is the most dangerous form of bleeding, and requires immediate attention.
- (2) **Venous bleeding.**—When a vein is cut the blood flows in a sluggish steady stream, with no trace of a jet or spurt. It comes from the side further from the heart and in colour is of a dark red-purple.
- (3) **Capillary bleeding.**—When the capillaries are broken there is a general oozing of red blood, but no jet or spurt and no steady stream.

First Aid in Hæmorrhage.—To arrest bleeding the following methods may be employed.

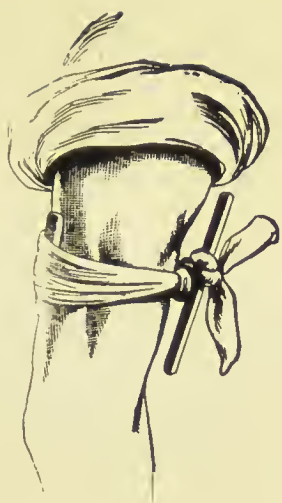
- (1) Raise the wounded part, if a limb, above the level of the body, the patient having first been laid down.
- (2) Apply pressure to the wound with the fingers or thumb. Meantime a pad consisting of several folds of linen should be prepared and pressed upon the wound. This should then be bandaged on, a piece of cork or a penny being placed in the folds of the bandage and laid over the pad to keep it in its place.



- (3) If bleeding comes freely through the bandage, a **tourniquet** should be put on the limb on the side from which the blood comes, that is, in arterial bleeding, between the wound and the heart. A **tourniquet** for first aid purposes can be made from a handkerchief folded narrow with a pad (wood, cork, smooth stone, etc.) in the folds. This is placed over the line of the blood-vessel and the handkerchief tied round the limb. By means of a stick it is then twisted tightly. If

medical aid is not forthcoming soon, the tourniquet should be gradually loosened, and should be kept only so tight as to prevent bleeding.

- (4) **Apply cold** to the wound, by means of cold water, ice, or snow. This often stops the bleeding.
- (5) **Apply styptics**, that is substances which quickly form a blood clot. The commonest is tannin dissolved in its own weight of water, and applied as a wash. Alum, gall-nuts in powder or infusion, and salts of iron (as steel drops) are other styptics.



A TOURNIQUET.

Special cases of bleeding.

- (1) **Bleeding from the nose.**—The head should be raised



and the arms thrown up and slightly behind the head. Cold should be applied to the top of the nose and the back of the neck. (Cloths wrung out of cold water, ice, keys, etc. may be used).

- (2) **Bleeding from the lungs**—blood spitting. The blood thus coughed up is bright scarlet and frothy.

- (3) **Bleeding from the stomach**—blood vomiting. The blood

thus vomited is dark in colour, and sometimes has the appearance of being partly clotted.

First aid in both cases consists of laying the patient down with the head somewhat raised. Cold should be applied to the chest in the form of ice or cold water in an india-rubber bag. Ice should be sucked, or cold water or water with a little vinegar should be sipped slowly.

WOUNDS.

There are several varieties of wounds.

- (1) **Incised Wounds** or clean cuts such as might be inflicted with the edge of a knife, a sword, a razor.
- (2) **Punctured Wounds** or stabs with the point of a knife or sword.
- (3) **Lacerated or Torn Wounds** caused by a saw or other instrument, and having irregular and torn edges.
- (4) **Poisoned Wounds** which might be incised, punctured, or lacerated, with the addition of something which poisons the blood, as decomposing animal or vegetable matter, dirt, etc. Here may also be included the bites of venomous snakes, mad dogs, etc. and the stings of various insects.
- (5) **Contused Wounds or Bruises** where the parts around the wound are much crushed.
- (6) **Gunshot Wounds** caused by one or more bullets from a gun or revolver.

Treatment of Wounds.—In the case of serious wounds as above, the doctor should be at once sent for and **first aid** applied as advised below.

Incised, Punctured, or Lacerated Wounds.

1. Efforts should be first directed to **arresting the bleeding** by (1) application of cold water, (2) pressure by the fingers on the wound itself until a proper pad and bandage are ready: (3) raising the part if the wound is in a limb; or if the bleeding is severe by such methods as are described on pp. 64 and 65. Usually, bleeding is most profuse after a clean cut, and excessive bleeding must be stopped before the wound is bound up.

2. If there is any suspicion that the wound is dirty it should be **carefully cleaned**, unless the bleeding is excessive,

when it is desirable to form a clot on the wound as soon as possible. To clean a wound pure water poured on it from some height is best. If this does not remove all the dirt, a clean linen rag or camel hair brush dipped in pure water may be introduced carefully into the wound. A solution of carbolic acid, 1 part to 40 parts of water, is a very good lotion for washing out dirty cuts.

3. Carefully **adjust the edges** of the wound, placing them as nearly as possible in their natural position, and if necessary fix with strips of sticking plaster or strapping so placed that matter, if it forms, may have space by which to discharge.

4. **Dress** with a pad of soft linen wetted with pure water and fix this in position with a handkerchief bandage. If a limb, the injured part should be supported in a sling or rested on chair, etc.

Poisoned Wounds.

Besides the treatment mentioned above for ordinary unpoisoned wounds, the following special precautions should be adopted in the case of poisoned wounds.

Where the poison is some form of **dirt**, wash well with a strong disinfectant as carbolic acid, 1 to 10 parts of water, Condy's fluid, etc.

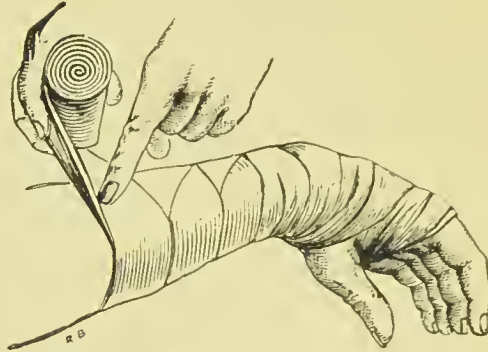
In the case of bites and stings someone should at once suck the wound, afterwards thoroughly rinsing out his mouth. It is necessary that care be taken that there are no cracks about the mouth or lips or tongue, otherwise the poison may enter there. Wash with warm water for some time to encourage free bleeding. If the wound is in a limb apply constriction between the wound and the heart (see page 64). Cauterise the wound with a red hot wire or with lunar caustic and wash with disinfectant solutions as above. The pain of a sting is much relieved by washing with a solution of ammonia or soda. If the insect's sting is left in the wound it should first be extracted by pressure with a watch key.

Bruises and Gunshot Wounds.

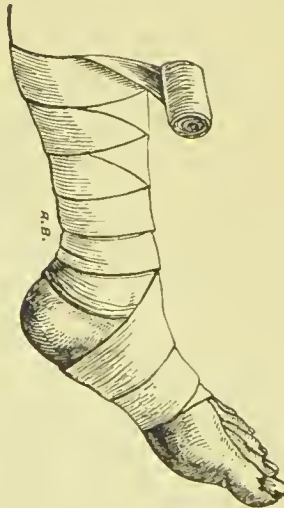
The first aid for these is to arrest the bleeding by applying a cold compress and bandage. The doctor should be at once sent for in the latter case, as bullets may have to be extracted.

Bandages.

Bandages are strips or pieces of calico, linen, etc., used to envelop any part of the body requiring artificial support, to produce pressure on any part, or to retain dressings in their proper places. To apply a bandage well requires both care and practice. It is, however, a very useful accomplishment, and should be practised at first on someone in sound health.



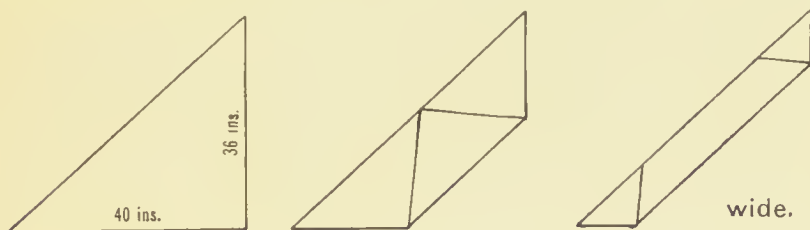
REVERSING A BANDAGE.



REVERSED
SPIRAL BANDAGE.

The width of a strip bandage will depend upon the part of the body to which it is to be applied, and may vary from $\frac{3}{4}$ inch

to 2 inches or more. Ordinary unbleached calico is a very suitable material. It should be rolled up firmly. This roll is kept in the right hand and the end is secured by the first turn, each subsequent turn slightly overlapping the previous one. Inequalities in girth are best overcome by reversing the bandage, the surface of the cloth which was next the skin being turned outwards.



Another important form of bandage is the **triangular bandage**. This is perhaps the most useful form for **first aid**. A piece of linen or calico 40 inches by 36 inches is cut across a diagonal, or a good-sized handkerchief folded along its diagonal may be used.

According to the purpose for which it is to be used it may be folded **narrow** or **wide**. If wanted wide it should be folded twice, the corner being brought to the middle of the long side as shown above. For a narrow bandage it is again folded.

It is better in most cases to fasten the bandage by means of safety pins rather than knots.

A wide triangular bandage is also used as a **sling** for supporting, say, a broken arm. In this case the ends are carried round the patient's neck and there knotted or pinned.

FRACTURES OR BROKEN BONES.

There are several forms of fractures :—

- (1) A **simple fracture**.—When the bone is broken in two but little or no other damage is done.
- (2) A **comminuted fracture**.—When the bone is broken in several places—it may be shattered as in some forms of gunshot wounds.
- (3) A **compound fracture**.—Where, in addition to the broken bone there is a wound in the flesh leading from the outside to the broken ends of the bone. In this case, nerves, blood-vessels, etc. may be injured. This is a very serious form of fracture.

- (4) A **complicated fracture**.—Where, in addition to the fracture, some important organs of the body, as the brain, the lungs, large blood-vessels or nerves are injured. This also is a very serious injury.

How to know that a bone is broken.

- (1) **Muscular power** over the part is **lost**—if a limb, it lies motionless and helpless.
- (2) **The shape is altered** as compared with the uninjured side—usually if a limb it is bent and shortened.
- (3) There is **swelling** and **pain**—especially if the broken ends overlap.
- (4) The part (if a limb) can be **moved unnaturally** if taken hold of gently.
- (5) The **grating** or rubbing together of the broken ends of the bone can be felt if the injured part is gently and carefully moved.

First Aid in Fractures.—If a doctor is within reach he should at once be sent for. Meantime the fracture should be attended to on the spot where the accident has occurred. Great care must be exercised in handling the body of the patient, otherwise a simple fracture may be converted into a compound or complicated one. If a broken limb must be moved it should be grasped firmly **from underneath**—one hand above the fracture and the other below it. Clothing which must be removed should be **cut up the seams** and on no account pulled off. The fractured parts should be returned to their natural position. To do this gentle pulling is generally necessary. When this has been done they should be immovably supported in this position.

Splints and Stretchers.—To give immovable support to a fractured bone **splints** are necessary. These may be improvised out of pieces of thin board, laths, rulers, stout cardboard, book-backs, pointers, walking sticks, broom handles, umbrellas, etc., a length being chosen to suit the length of the injured limb. Between the limb and the splints some soft **padding** must be placed, as handkerchiefs, flannel, newspapers, towels, straw, etc. The splints are then tied firmly by means of triangular bandages (see page 69) as handkerchiefs, etc.

In case of removal, **stretchers** should be used where any

APPLYING SPLINTS TO A BROKEN LEG.

important bone has been broken. They can be improvised in a variety of ways, as two poles with blankets or carpet, etc. rolled round them, or a door or shutter well padded with clothes, etc.

DISLOCATIONS.

A dislocation occurs when a bone is put out of joint by any cause. A dislocation may be distinguished from a fracture by the fact that the limb affected becomes **fixed and immovable**, and there is **no grating** of bone ends to be felt. As in the case of fracture there is **loss of power, change of shape, pain and swelling**.

First aid in dislocation consists in fixing the limb as comfortably as possible by means of slings (See page 69) or splints (as in the case of fractures) and the application of cold water rags. The doctor should be sent for, and no attempt made by the inexperienced to return the bone to its joint.

SPRAINS AND STRAINS.

A **sprain** is the sudden stretching or tearing of the tendons and ligaments about a joint.



A **strain** is the overstretching of muscles by too great exertion, followed by pain and stiffness

First Aid.

- (1) For a **sprain** put on a tight bandage or a splint, so that the joint may have complete rest. If they can be borne without pain apply cold foment, ice, or a mixture of equal parts of spirits and water. If these are too painful use hot foment.
- (2) For a **strain** apply hot foment until the pain is lessened and then rub with embrocation.

Foment.—Flannel or woollen cloth is wrung out of water of the proper temperature and applied to the body. The average time to continue fomentation on one occasion is an hour; but the cloths should be changed from five to eight times during that period.

BRUISES.

The effect of a bruise is to cause effusion of blood into the surrounding tissues, causing discoloration (as a black eye).

First aid.—The best application is ice-cold water in cloths, sponges, or indiarubber bags, or a mixture of spirits and water in equal parts. If the bruise is severe and inflammation likely to follow hot fomentations or scalded bran poultices should be used.

BURNS AND SCALDS.

A **burn** is caused by dry heat from fire. A **scald** is caused by moist heat as from boiling water.

First Aid.—If the burn or scald is at all severe or extensive the doctor should be at once sent for.

Case of a person's clothes catching fire.—Throw the person on the floor and roll up in some heavy woollen material as rug, blanket, tablecover, carpet, overcoat, etc., and thoroughly drench with cold water. Any clothing that must be removed should be slit up the seams and not pulled off. Should any portion adhere, it should be cut around and left.

Treatment.—The patient must be kept warm, as those who have suffered from burning invariably tend to feel cold and depressed. **The air must be excluded from the burned surface.** This may be effected in a great variety of ways. The burned part may be coated by means of a feather with some oily substance, as an oil, or butter, etc. The best

dressing is what is known as **Carron oil**, which consists of linseed oil and lime water in equal parts. Over this a layer of linen or muslin steeped in the oil should be placed and the whole covered with cotton wool. If no oil is at hand, the burned part may be well dusted with powdered chalk, flour or arrowroot, or starch. After the blisters which may form break, a simple tepid bread and water poultice should be applied for six or eight hours and followed by lint dressing with either boracic or carbolic ointment.

Burns caused by chemicals should be first thoroughly drenched with cold water to remove the chemical. If caused by an **acid** as sulphuric acid (vitriol), carbolic acid, etc., bathe with water and soda or lime; if caused by an **alkali** as caustic soda or potash, etc. bathe with water and vinegar. In either case follow with the treatment for an ordinary burn or scald as given above.

POISONS.

Poisons are usually divided into three classes :—

- (1) **Irritants** as (a) the various compounds of arsenic, lead, mercury, copper, antimony and zinc, (b) various acids as hydrochloric, sulphuric, nitric, oxalic and carbolic acids, also iodine, phosphorus, etc., (c) irritant gases as chlorine, etc.;
- (2) **Narcotics** as belladonna (deadly nightshade), morphia, opium, prussic acid, alcohol;
- (3) **Narcotic irritants**, as aconite (monkshood), strychnia (nux vomica), digitalis (foxglove), poisonous fungi (mushrooms).

First Aid.—In all cases of poisoning a doctor should at once be sent for. Meantime, an effort should be made to have the poison vomited, either by tickling the throat with a feather or the finger or by administering an **emetic**. The best and safest emetics are the simplest, as a tablespoonful of salt or mustard in a tumbler of warm water, a tablespoonful of ipecacuanha wine, or half a teaspoonful of sulphate of zinc (white vitriol) in a glass of warm water.

If the poison has been a corrosive acid, however, no emetic must be administered.

If possible (and if the nature of the poison is certainly known) an **antidote** should also be given.

The following table gives the antidotes recommended for the commoner poisons.

POISON.	ANTIDOTE.
Mineral acids . . .	{ Chalk, whiting, magnesia or washing soda in milk or water.
Phosphorus . . . (heads of matches)	{ No oil must be given, but any other purgative, and whites of eggs beaten up with magnesia.
Carbolic acid . . .	{ Olive oil or other sweet oil and magnesia.
Caustic soda, potash, lime, or ammonia . . .	{ Vinegar or lemon juice.
Arsenic and its compounds	{ A tablespoonful of dialysed solution of iron followed by teaspoonful doses every ten minutes.
Lead, mercury, copper, antimony, and zinc compounds	{ Emetics, white of egg, milk, chalk, magnesia, flour and water.
Irritant gases . . .	{ Remove into fresh air and get patient to inhale steam.
Belladonna	{ Chalk and magnesia and strong tea and coffee.
Morphia and opium . .	{ Dash cold water over patient and keep him walking about to prevent sleeping. Mustard poultices to the limbs.
Prussic acid	{ Carbonate of potash followed by sulphate of iron.
Alcohol	Emetics.
Aconite, strychnia, digitalis (foxglove), fungi . .	{ Sulphate of zinc emetic, followed by barley water or white of egg. and, if necessary, stimulants as brandy and water.
Foxglove	Tannin or strong tea.
Fungi	Emetics and castor oil.

INSENSIBILITY.

Insensibility may be due to a great variety of causes, and the first aid to be given will vary very widely. The following is a summary of the subject.

1. **Shock.**—A shock in medical language means the depressing influence imparted to the nervous system, and through it to the constitution generally, as a consequence of severe pain or injury. Thus, a blow over the heart, great loss of blood, etc. would be followed by **shock**. Under severe shock the patient gradually sinks. This is known as **Collapse**. The face and hands are pale, pinched, and clammy, the breathing is feeble, and the pulse can scarcely be felt.

First Aid.—The patient should be laid out flat and any tight clothing loosened. He should be kept warm with clothing, hot water bottles, etc. The hands and body should be chafed. If quite unconscious he should get nothing by the mouth, but ammonia or smelling salts may be held to the nostrils. If he is partly conscious, warm broth, tea, or brandy and water may be given cautiously.

2. **Fainting.**—This is caused by an insufficient supply of blood to the brain, as a result of weakness, want of food, fatigue, pain, emotion, etc. Usually there is a feeling of giddiness before insensibility.

First Aid is similar to that given under "Shock." The head may be held below the level of the body to induce a flow of blood to the brain, and cold water dashed in the face is helpful.

3. **Concussion of the Brain.**—This is caused by blows on the head, a fall, etc. There is giddiness and a confused feeling, the skin is cold and pale and the pulse is weak. In severe cases the patient is quite insensible.

First aid is much the same as in previous cases, but in addition hot water bottles should be put to the feet and cold (ice or cloths in water) to the head.

4. **Fits** may include falling sickness, hysterical fits, etc. These are well known. **First aid** consists in removing the patient to a place of safety, loosening all tight clothing, and arranging that the patient may not injure himself during the fit. Place a cork or small piece of wood between the teeth to prevent the patient biting his tongue. Allow the fit to follow its natural course, and then the patient should be encouraged to fall asleep.

DROWNING.

When a person who cannot swim falls into the water, he can keep himself from sinking if he throws his head well



back so as to keep his mouth out of the water. He should keep his lungs well filled with air and on no account throw his arms above the surface.



Persons who are **apparently drowned** have often been restored to life by the following method.

- (1) Remove the wet clothes and cover the patient but lightly.
- (2) Lay him on his stomach with folded clothes underneath, so that the water in the mouth and air passages may drain out.
- (3) Then lay him on his back with a cushion under his shoulders, open the mouth and draw forward the tongue, keeping it projecting by means of tape or elastic band round under the chin.
- (4) **Artificial breathing.**—Standing at the patient's head grasp his arms just below the elbows and draw them gently and steadily up to the sides of the head, keeping them there for about two seconds. Then take them back again and press them against the sides of the chest for two seconds. Repeat these movements, thus imitating breathing, which is naturally about fifteen times a minute. Applying smelling salts to the nose, and tickling the throat with a feather will help.
- (5) When breathing begins naturally heat and circulation must be restored. The limbs should be rubbed briskly *towards the heart*, and hot water bottles should be applied to the feet, the sides, the stomach and the chest. When consciousness returns, warm water followed by hot brandy and water should be given in teaspoonfuls.

Artificial breathing is also employed in cases of hanging and suffocation.

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